PASADENA
Water&Power

2010 Urban Water Management Plan

FINAL

June 2011

CDM

Table of Contents

List of Tables

List of Figures

List of Abbreviations

AF	acre-foot or acre-feet
AFY	acre-feet per year
BMP	best management practice
CII	commercial, industrial, and institutional
City	City of Pasadena
CUWCC	California Urban Water Conservation Council
cfs	cubic ft/sec
CRA	Colorado River Aqueduct
DMM	demand management measures
DWR	California Department of Water Resources
ET	evapotranspiration
EUAP	Electricity Utility Assistance Program
GCMs	general circulation models
gpcd	gallons per capita per day
gpd	gallons per day
gpf	gallon per flush
HET	high efficiency toilet
HEW	high-efficiency washing machine
HUD	United States Department of Housing and Urban Development
LACDPW	Los Angeles County Department of Public Works
LACSD	Los Angeles County Sanitation District
LAGWRP	Los Angeles/Glendale Water Reclamation Plant
MAWA	Maximum Applied Water Allowance
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
MHTS	Monk Hill Treatment System
MOU	Memorandum of Understanding
MWD	Metropolitan Water District of Southern California
ppm	parts per million
PWP	Pasadena Water & Power
RBMB	Raymond Basin Management Board
RWMP	Recycled Water Master Plan
SCAG	Southern California Association of Governments
SWP	State Water Project
SWRCB	State Water Resources Control Board
ULFT	ultra-low flow toilet
UWMP	Urban Water Management Plan
WBIC	Weather-Based Irrigation Controller
WIRP	Water Integrated Resources Plan
WSAP	Water Supply Action Plan
WSDM	Water Surplus and Drought Management

Executive Summary

ES.1 Urban Water Management Planning Act

All urban water suppliers within the State of California are required to prepare Urban Water Management Plans. California Water Code Sections 10610 through 10657 detail the information that must be included in these plans as well as who must file them. This Urban Water Management Plan satisfies the requirements of the Urban Water Management Planning Act (the Act) of 1983 and the subsequent amendments to the Act. According to the Act, an urban water supplier is defined as a supplier, either publicly or privately owned, that provides water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually.

This report constitutes the Pasadena Water & Power (PWP) 2010 Urban Water Management Plan (UWMP). Urban water suppliers are required to update their UWMPs at least once every five years on or before December 31, in years ending in five and zero. This plan shall be adopted by the City of Pasadena (City) and submitted to the California Department of Water Resources (DWR). The UWMP requires analyses of management tools and options that will maximize resources and minimize the need to import water from other regions. An analysis of total projected water use compared to water supply sources over the next 20 years in five-year increments is required. Water quality, as it affects water management strategies and supply reliability, is addressed in this UWMP. Water demand and supply information is compared for single dry year and multiple dry year scenarios.

There have been several important changes in the Act since 2005, which include:

- Clarifies that every urban water supplier preparing a plan must give at least 60 days advance notice to any city or county prior to the public hearing on the UWMP within which the supplier provides water supplies to allow opportunity for consultation on the proposed plan (Water Code § 10621(b)).
- Requires urban retail water suppliers to include baseline daily per capita water use, urban water use targets, interim urban water use targets, and compliance daily per capita water use, along with the basis for determining those estimates, including references to supporting data.
- Requires plan by retail water suppliers to include water use projections for single-family and multi-family residential housing needed for lower income and affordable households to assist with compliance with the existing requirement under Section 65589.7 of the Government Code that suppliers grant a priority for the provision of service to housing units affordable to lower income households (Water Code § 10631.1).

- Conditions eligibility for a water management grant or loan made to an urban water supplier and awarded or administered by DWR, the State Water Resources Control Board, or the California Bay-Delta Authority or its successor agency on the implementation of water demand management measures, including consideration of the extent of compliance with the conservation measures described in the California Urban Water Conservation Council's (CUWCC) Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California (Water Code § 10631.5).
- Exempts projects funded by the American Recovery and Reinvestment Act of 2009 from the conditions placed on state funding for water management to urban water suppliers (Water Code § 10631.5(a)(2)).
- Requires DWR, in consultation with the State Water Resources Control Board and the California Bay-Delta Authority or its successor agency, to develop eligibility requirements to implement the foregoing grant and loan conditions (Water Code § 10631.5(b)), and repeals existing grant funding conditions of state water management grants or loans on July 1, 2016 if the UWMP is not extended or altered prior to this date (Water Code § 10631.5(f)).

Senate Bill 7

In addition to changes to the Act, the State Legislature passed Senate Bill 7 as part of the Seventh Extraordinary Session, referred to as SBX7-7, on November 10, 2009, which became effective February 3, 2010. This new law was the water conservation component to the historic Delta legislative package, and seeks to achieve a 20 percent statewide reduction in urban per capita water use in California by December 31, 2020. This implements similar 2008 water use reduction goals. The law will require each urban retail water supplier to develop urban water use targets to help meet the 20 percent goal by 2020, and an interim urban water reduction target by 2015.

The bill states that the legislative intent is to require all water suppliers to increase the efficiency of use of water resources and to establish a framework to meet the state targets for urban water conservation. The bill establishes methods for urban retail water suppliers to determine targets to help achieve increased water use efficiency by the year 2020. To give retail urban water suppliers time to conduct the additional required analyses, SBX7-7 grants an extension for adoption of UWMPs due in 2010 to July 1, 2011 (Water Code § 10608.20(j)). Urban retail water suppliers, such as the City, are to prepare a plan for implementing the Water Conservation Bill requirements and discuss this implementation plan at a public meeting (Water Code § 10608.26).

ES.2 PWP Service Area Background and Water Supplies

PWP's service area is located within the northwestern portion of the San Gabriel Valley in Los Angeles County, encompassing approximately 23 square miles, and is slightly larger than the legal boundary of the City of Pasadena. PWP serves portions of unincorporated areas of Altadena, East Pasadena, and San Gabriel. The service area is bordered on the north by unincorporated Altadena and the Angeles National Forest, on the east by Arcadia and Sierra Madre, on the south by South Pasadena and San Marino, and the west by Los Angeles, Glendale, and La Canada Flintridge.

Pasadena's weather is characterized as a Mediterranean climate. Temperatures are mild in winter, spring and fall, and hot and dry during summer months. Total precipitation in Pasadena averages about 20 inches per year and approximately 71% falls between January and March. Typically, August is the hottest months of the year with an average daily maximum temperature of 89°F. The average daily maximum temperature in winter months is approximately 68°F.

PWP's historical water demands have varied from year to year, mainly attributed to annual variations in weather, but also due to economic activity and droughts. When normalized for these conditions, water demands in the service area have increased approximately 0.5% per year. Currently, water demands are approximately 30,000 AFY, which is about 22% lower than in 2007. This significant reduction in demand is due to mandatory restrictions in water use that PWP implemented in response to a multi-year drought that began in 2008 and ended in 2010, as well as a severe economic recession during this same time. It is estimated that if these two events did not occur, current water demands would be approximately 38,000 AFY. Based on projected demographics (housing and employment) forecasted by the Southern California Association of Governments (SCAG), normal water demands for PWP are projected to be about 43,000 AFY by 2035. This demand forecast assumes current levels of active water conservation as well as future water use efficiency from compliance with California's plumbing codes.

PWP's current water supplies include local groundwater from the Raymond Basin, surface water diversions, and purchases of imported water. In average hydrologic conditions, PWP is currently pumping approximately 12,000 acre-feet per year (AFY) from the Raymond Basin. However, due to declining groundwater levels, the Raymond Basin Management Board (RBMB) has implemented a resolution to all pumpers in the basin that reduces groundwater rights over a five year period. For PWP, this resolution results in a groundwater pumping right of approximately 10,300 AFY. Surface water diversions in the Arroyo Seco and Eaton Canyon are used to augment local groundwater, and now average approximately 2,380 AFY.

To meet the remaining water needs for PWP imported water is purchased from the Metropolitan Water District of Southern California (MWD). MWD is the regional water wholesaler and is comprised of 26 public member agencies. Pasadena is one of these member agencies, and was one of the founding member cities of MWD. Since 1990, historical purchases of MWD water have ranged from a low of 13,000 AFY to a high of 32,000 AFY. MWD obtains its primary water supplies from the State Water Project (SWP) and Colorado River Aqueduct (CRA). Both of these sources of water have become more unreliable since the early 1990's as a result of significant droughts, water rights issues, and environmental restrictions. The SWP supply must pass through California's Sacramento-San Joaquin Delta (Delta), which is the largest estuary in the state and the source of many conflicts between urban, agriculture and environmental interests. Due to endangered species act requirements, Delta water exports were significantly curtailed in recent years. The issues in the Delta are expected to continue unless a comprehensive solution is implemented restoring the Delta's ecosystem and providing additional conveyance and storage to reduce impacts of water exports on fisheries and habitats.

ES.3 Water Integrated Resources Plan

In January 2011 PWP completed a Water Integrated Resources Plan (WIRP) providing an overall long-term water resources strategy through the year 2035. The WIRP serves as the primary source document for preparation of this UWMP. The WIRP was developed using a participatory process, with input from a dedicated stakeholder Advisory Committee and the public at large. Planning objectives were developed by the Advisory Committee and evaluation criteria or metrics were established in order to evaluate various alternatives to meet future water demands. Approximately 50 water supply and conservation options were considered in the WIRP. After extensive evaluation, a recommended supply portfolio that increases water conservation and local water supplies was determined to be the best strategy.

In conjunction with the WIRP, PWP has been developing a recycled water master plan (RWMP) to identify potential demands and projects that could be developed. The information from the RWMP was incorporated into the WIRP and this UWMP. The other source document for this UWMP is MWD's 2010 Regional Urban Water Management Plan, which provides information regarding the reliability of imported water from SWP and CRA, as well as MWD's water storage, banking and transfer programs.

ES.4 Water Reliability Summary

This UWMP details the required information regarding water supply sources (current and projected), water quality issues that may affect supplies, conservation practices implemented, shortage contingency planning, and overall supply reliability. Tables ES-1 and ES-2 show the supply reliability based on the preferred strategy developed in the WIRP for an average and single dry year weather condition.

Table ES-1. Water Supply and Demand Comparison for a Normal Hydrologic Condition

Supply / Demand (AFY)	2010	2015	2020	2025	2030	2035
Existing Groundwater	12,056	10,304	10,304	10,304	10,304	10,304
Existing Surface Water Diversion	2,380	2,380	2,380	2,380	2,380	2,380
Imported Water from MWD	24,024	23,626	21,149	21,149	21,149	21,149
Planned Recycled Water	0	1,130	2,050	2,050	2,050	2,050
Planned Stormwater Harvesting	0	0	627	627	627	627
Planned Groundwater Storage Program	0	0	0	0	0	0
Total Supply	38,460	37,440	36,510	36,510	36,510	36,510
Demand Projection w/o New Conservation	38,460	39,940	41,510	42,490	43,010	43,380
Planned Water Conservation	0	2,500	5,000	5,980	6,500	6,870
Total Demand	38,460	37,440	36,510	36,510	36,510	36,510
Surplus/Shortage	0	0	0	0	0	0
Surplus/Shortage as % of Supply	0%	0%	0%	0%	0%	0%
Surplus/Shortage as % of Demand	0%	0%	0%	0%	0%	0%

Table ES-2. Water Supply and Demand Comparison for a Single-Year Dry Hydrologic Condition

Supply / Demand (AFY)	2010	2015	2020	2025	2030	2035
Existing Groundwater	12,056	10,304	10,304	10,304	10,304	10,304
Existing Surface Water Diversion	660	660	660	660	660	660
Imported Water from MWD	25,744	25,346	20,306	20,306	20,306	20,306
Planned Recycled Water	0	1,130	2,050	2,050	2,050	2,050
Planned Stormwater Harvesting	0	0	190	190	190	190
Planned Groundwater Storage Program	0	0	3,000	3,000	3,000	3,000
Total Supply	38,460	37,440	36,510	36,510	36,510	36,510
Demand Projection w/o New Conservation	38,460	39,940	41,510	42,490	43,010	43,380
Planned Water Conservation	0	2,500	5,000	5,980	6,500	6,870
Total Demand	38,460	37,440	36,510	36,510	36,510	36,510
Surplus/Shortage	0	0	0	0	0	0
Surplus/Shortage as % of Supply	0%	0%	0%	0%	0%	0%
Surplus/Shortage as % of Demand	0%	0%	0%	0%	0%	0%

Section 1
Introduction

1.1 Urban Water Management Planning Act

All urban water suppliers within the State of California are required to prepare Urban Water Management Plans. California Water Code Sections 10610 through 10657 detail the information that must be included in these plans as well as who must file them. This Urban Water Management Plan satisfies the requirements of the Urban Water Management Planning Act (the Act) of 1983 and the subsequent amendments to the Act. According to the Act, an urban water supplier is defined as a supplier, either publicly or privately owned, that provides water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually.

This report constitutes the Pasadena Water & Power (PWP) 2010 Urban Water Management Plan (UWMP). Urban water suppliers are required to update their UWMPs at least once every five years on or before December 31, in years ending in five and zero. This plan shall be adopted by the City of Pasadena (City) and submitted to the California Department of Water Resources (DWR). The UWMP requires analyses of management tools and options that will maximize resources and minimize the need to import water from other regions. An analysis of total projected water use compared to water supply sources over the next 20 years in five-year increments is required. Water quality, as it affects water management strategies and supply reliability, is addressed in this UWMP. Water demand and supply information is compared for single dry year and multiple dry year scenarios.

1.2 Law

California Water Code Section:

10620 (d) (2) each urban water supplier shall coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable.

10621 (b) Every urban water supplier required to prepare a plan pursuant to this part shall notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. The urban water supplier may consult with, and obtain comments from, any city or county that receives notice pursuant to this subdivision.

10621 (c) The amendments to, or changes in, the plan shall be adopted and filed in the manner set forth in Article 3 (commencing with Section 10640).

10635 (b) The urban water supplier shall provide that portion of its urban water management plan prepared pursuant to this article to any city or county within which it provides water supplies no later than 60 days after the submission of its urban water management plan.

10642. Each urban water supplier shall encourage the active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan. Prior to adopting a plan, the urban water supplier shall make the plan available for public inspection and shall hold a public hearing thereon. Prior to the hearing, notice of the time and place of hearing shall be published. After the hearing, the plan shall be adopted as prepared or as modified after the hearing.

1.2.1 Changes in the Act Since 2005

Since 2005, several amendments have been added to the Act. Some of the amendments provided for reporting on lower income and affordable household water projections, eligibility for state water management grants or loans, and reporting on the feasibility of serving recycled water demands. The following is a summary of the significant changes in the Act that have occurred from 2005 to the present:

- Clarifies that every urban water supplier preparing a plan must give at least 60 days advance notice to any city or county prior to the public hearing on the UWMP within which the supplier provides water supplies to allow opportunity for consultation on the proposed plan (Water Code § 10621(b)).
- Requires urban retail water suppliers to include baseline daily per capita water use, urban water use targets, interim urban water use targets, and compliance daily per capita water use, along with the basis for determining those estimates, including references to supporting data.
- Requires plan by retail water suppliers to include water use projections for single-family and multi-family residential housing needed for lower income and affordable households to assist with compliance with the existing requirement under Section 65589.7 of the Government Code that suppliers grant a priority for the provision of service to housing units affordable to lower income households (Water Code § 10631.1).
- Conditions eligibility for a water management grant or loan made to an urban water supplier and awarded or administered by DWR, the State Water Resources Control Board, or the California Bay-Delta Authority or its successor agency on the implementation of water demand management measures, including consideration of the extent of compliance with the conservation measures described in the California Urban Water Conservation Council's (CUWCC) Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California (Water Code § 10631.5).
- Exempts projects funded by the American Recovery and Reinvestment Act of 2009 from the conditions placed on state funding for water management to urban water suppliers (Water Code § 10631.5(a)(2)).
- Requires DWR, in consultation with the State Water Resources Control Board and the California Bay-Delta Authority or its successor agency, to develop eligibility requirements to implement the foregoing grant and loan conditions (Water Code § 10631.5(b)).
- Repeals existing grant funding conditions of state water management grants or loans on July 1, 2016 if the UWMP is not extended or altered prior to this date (Water Code § 10631.5(f)).
- Deems water suppliers that are members of the CUWCC and comply with the MOU, as it may be amended, to be in compliance with the requirement to describe the supplier's water demand management measures in its urban water management plan (Water Code § 10631(j)).
- Required DWR, in consultation with the CUWCC, to convene a technical panel, no later than January 1, 2009, to provide information and recommendations to the Department and the Legislature on new demand management measures, technologies, and approaches. The panel and DWR were to

report to the Legislature on their findings no later than January 1, 2010 and each five years thereafter (Water Code § 10631.7.3).

- Clarifies that "indirect potable reuse" of recycled water should be described and quantified in the plan, including a determination with regard to the technical and economic feasibility of serving those uses (Water Code § 10633(d)).
- Requires DWR to recognize exemplary efforts by water suppliers by obligating DWR to identify and report to the technical panel, described above, any "exemplary elements" of individual water suppliers' plans, meaning any water demand management measures adopted and implemented by specific urban water suppliers that achieve water savings significantly above the levels required to meet the conditions to state grant or loan funding (Water Code § 10644(c)).

1.2.2 Senate Bill 7

In addition to changes to the Act, the State Legislature passed Senate Bill 7 as part of the Seventh Extraordinary Session, referred to as SBX7-7, on November 10, 2009, which became effective February 3, 2010. This new law was the water conservation component to the historic Delta legislative package, and seeks to achieve a 20 percent statewide reduction in urban per capita water use in California by December 31, 2020. This implements similar 2008 water use reduction goals. The law will require each urban retail water supplier to develop urban water use targets to help meet the 20 percent goal by 2020, and an interim urban water reduction target by 2015.

The bill states that the legislative intent is to require all water suppliers to increase the efficiency of use of water resources and to establish a framework to meet the state targets for urban water conservation. The bill establishes methods for urban retail water suppliers to determine targets to help achieve increased water use efficiency by the year 2020. The law is intended to promote urban water conservation standards consistent with the CUWCC's adopted best management practices.

Additionally, the bill specifically includes reporting requirements in the upcoming UWMPs. Specifically, urban retail water suppliers must include in their 2010 UWMPs the following information from its target-setting process: (1) baseline daily per capita water use; (2) urban water use target; (3) interim water use target; and (4) compliance daily per capita water use, including technical bases and supporting data for those determinations. An urban retail water supplier may update its 2020 urban water use target in its 2015 UWMP (Water Code § 10608.20).

To give retail urban water suppliers time to conduct the additional required analyses, SBX7-7 grants an extension for adoption of UWMPs due in 2010 to July 1, 2011 (Water Code § 10608.20(j)). Urban retail water suppliers, such as the City, are to prepare a plan for implementing the Water Conservation Bill requirements and discuss this implementation plan at a public meeting (Water Code § 10608.26).

1.3 Water Integrated Resources Plan

In January 2011 PWP completed a Water Integrated Resources Plan (WIRP) providing an overall long-term water resources strategy through the year 2035. The WIRP serves as source document for preparation of this UWMP. The WIRP was developed using an open, participatory process, with input from a dedicated stakeholder Advisory Committee and the public at large. Planning objectives were developed by the Advisory Committee, and evaluation criteria or metrics were established for these objectives in order to evaluate various alternatives to meet future water demands. Approximately fifty water supply and conservation options were considered in the WIRP. After extensive evaluation of the many different combinations of the various water supply and conservation options, a recommended supply portfolio that increases water conservation and local supplies was determined to be the best strategy. The phased WIRP

implementation strategy prioritizes those projects that offer the most benefits at the lowest costs, when compared to projected costs of purchasing imported water from the Metropolitan Water District of Southern California (MWD). Other projects will be phased in based on triggers that would measure actual water demands, MWD supply reliability, compliance with state regulations, and other factors. Throughout this UWMP, various components of the recommended supply portfolio are discussed where applicable.

In conjunction with the WIRP, PWP has been developing a recycled water master plan (RWMP) to identify potential demands and projects that could be developed. The information from the RWMP was incorporated into the WIRP.

1.4 Agency Coordination

PWP must coordinate its water supply planning with multiple agencies as it relies on a combination of local and non-local water supply sources. Local water supplies from groundwater require coordination with the Raymond Basin Management Board (RBMB). PWP is a member agency of the regional water importer, MWD, and must coordinate its imported water supply demands with MWD. The City's wastewater collection and treatment is provided by the Los Angeles County Sanitation Districts. PWP has an agreement with the City of Glendale for the use of recycled water from the Los Angeles/Glendale Water Reclamation Plant. Finally, since PWP provides water service to several adjacent areas outside of the City's boundaries it must coordinate with those communities.

Coordinating Agencies	Participated in developing the UWMP	Participated in developing the WIRP	Participated in developing the RWMP
Metropolitan Water District	X	X	
Glendale Water and Power			X
Foothill Municipal Water District			X
US Bureau of Reclamation			X
Raymond Basin Management Board	X	X	X
Los Angeles County Public Works	X	X	
Los Angeles County Sanitation Districts			X
Altadena	X	X	

1.5 Plan Adoption

Prior to updating the UWMP, PWP notified the County of Los Angeles that it would be reviewing the UWMP and considering amendments and changes. The County of Los Angeles was notified as a portion of PWP's service area extends into unincorporated areas as discussed in Section 2. A notice of public hearing to adopt the UWMP was provided pursuant to Section 6066 of the California Government Code (Appendix B). Additionally, the County of Los Angeles was notified of the time and place of the public hearing. A draft copy of the UWMP was made available prior to the public hearing via the City's website. A hearing was held considering adoption of the final UWMP, including a general discussion regarding PWP's implementation plan for complying with the Water Conservation Bill of 2009 (see section 3 for a discussion of the implementation plan). The final UWMP was adopted by the City Council at its scheduled Council meeting on June 6, 2011. Comments received at the public hearing are included in Appendix B. The City Council resolution of UWMP adoption is included in Appendix C. Final copies of the UWMP will be available to the public and will be provided to the California State Library and County of Los Angeles within 30 days of adoption.

Section 2
System Description

2.1 Law

California Water Code Section:

10631. A plan shall be adopted in accordance with this chapter and shall do all of the following:

> (a) Describe the service area of the supplier, including current and projected population, climate, and other demographic facts affecting the supplier's water management planning. The projected population estimates shall be based upon data from the state, regional, or local service agency population projections within the service area of the urban water supplier and shall be in five-year increments to 20 years or as far as data is available.

2.2 City Background

2.2.1 History and Government

PWP's service area is located within the northwestern portion of the San Gabriel Valley in Los Angeles County (see Figure 2-1). Encompassing approximately 23 square miles, the PWP service area is slightly larger than the legal boundary of the City of Pasadena and includes portions of the unincorporated areas of Altadena, East Pasadena, and San Gabriel. The service area is bordered on the north by unincorporated Altadena and the Angeles National Forest, on the east by Arcadia and Sierra Madre, on the south by South Pasadena and San Marino, and the west by Los Angeles, Glendale, and La Canada Flintridge.

2.2.2 Hydrologic Characteristics

The PWP service area is divided into two major drainage areas; the western portion of the service area drains to the Arroyo Seco, while the eastern portion drains to Eaton Wash. Small drainage areas in the central and southern portions of the service area drain to Alhambra Wash and Rubio Wash, and, along with the Eaton Wash, converge at the Rio Hondo. The Arroyo Seco eventually converges with the Los Angeles River, while the Rio Hondo collects water for the Rio Hondo Spreading Grounds before sending excess water to the Los Angeles River.

Figure 2-2 shows the major drainage watersheds within the service area. These watersheds are areas that drain surface runoff to creeks and water bodies in and adjacent to the service area. Mountain runoff from Arroyo Seco and Eaton Wash is collected in the Arroyo Seco Spreading Grounds and Eaton Wash Spreading Grounds, respectively, for recharge of Raymond Basin. The Arroyo Seco Spreading Grounds are owned by the City and operated by the Los Angeles County Department of Public Works, while the Eaton Wash Spreading grounds are owned and operated by the Los Angeles County Department of Public Works.

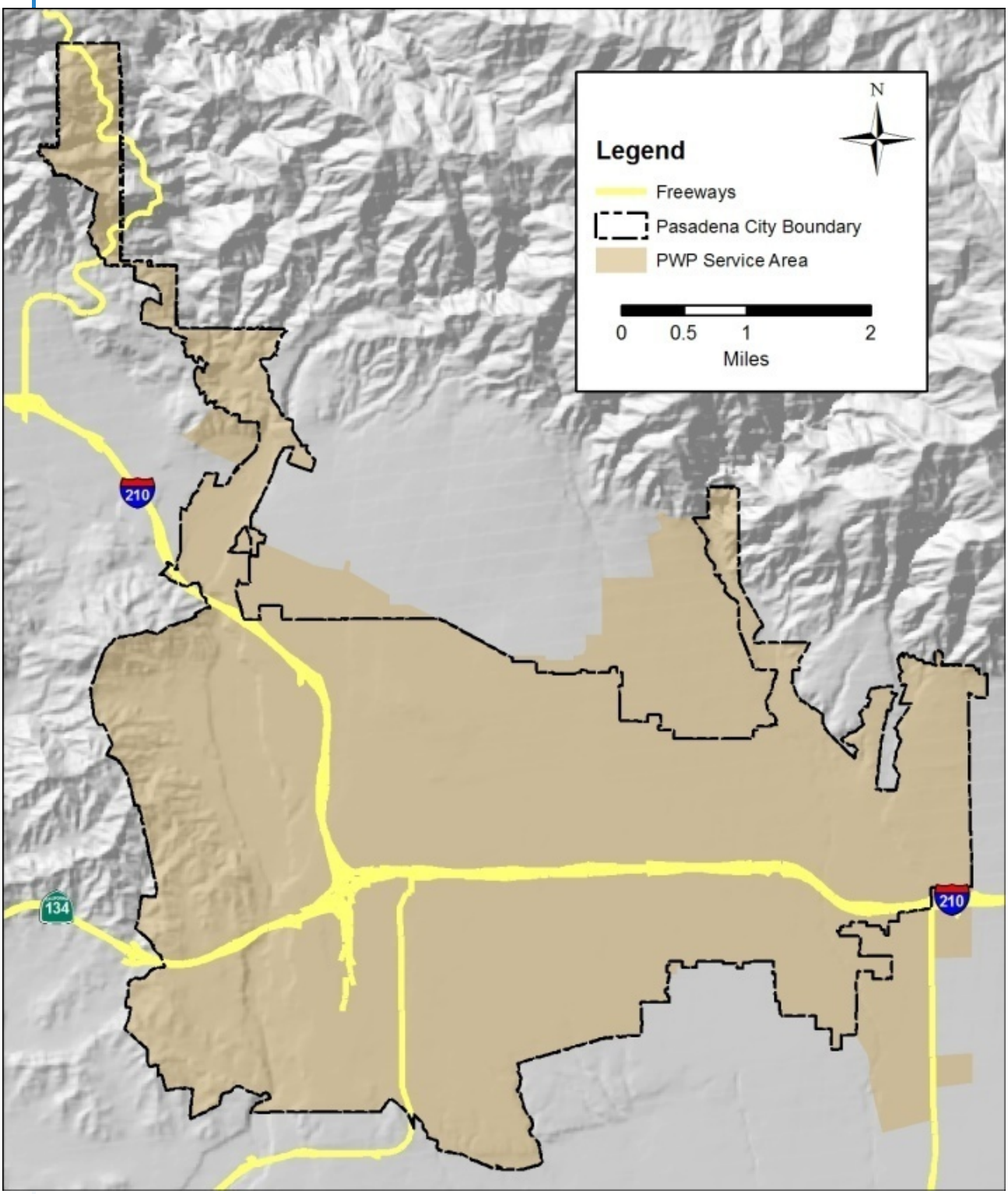

Figure 2-1. Service Area Map

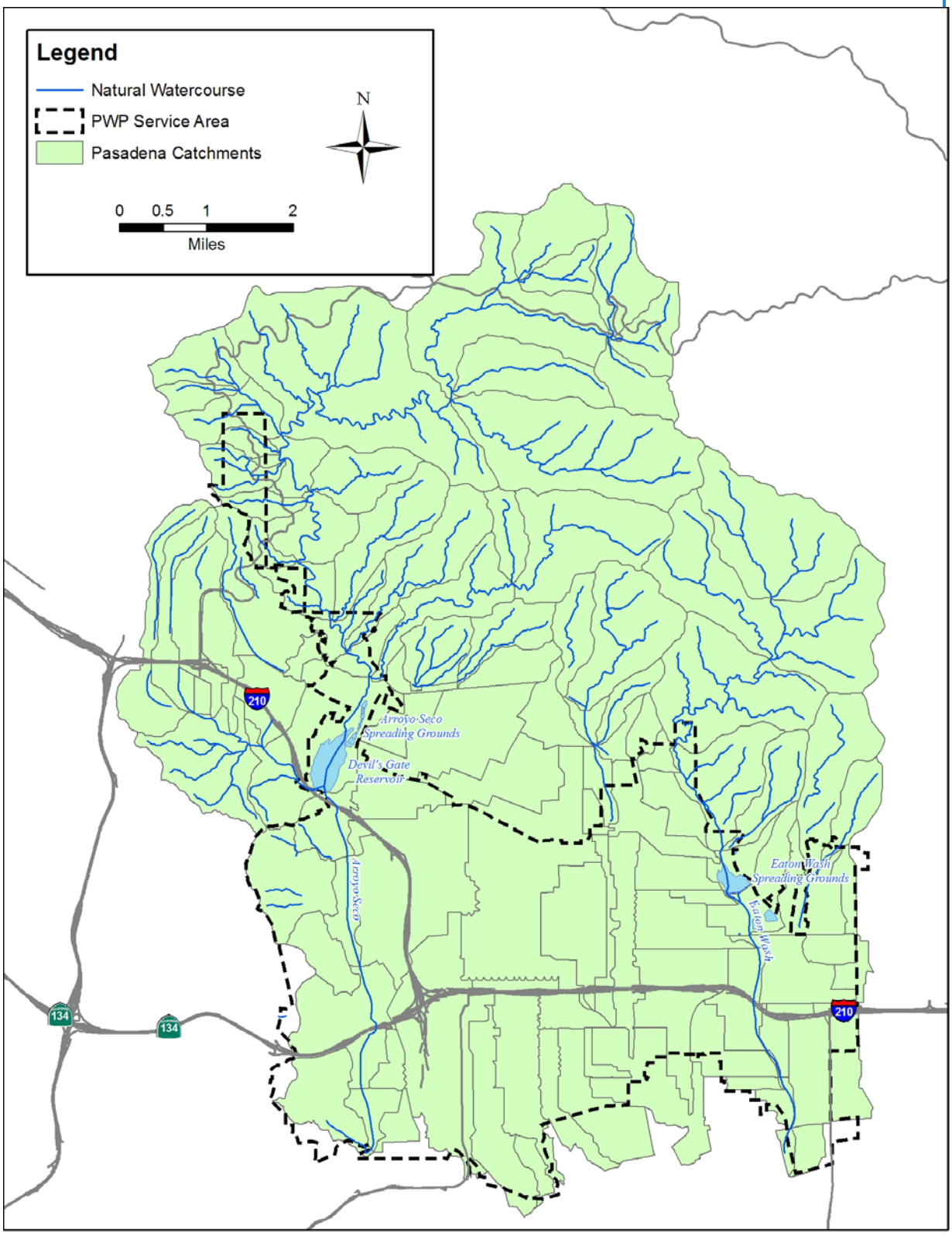

Figure 2-2. PWP Service Area Drainage Watersheds

2.3 Climate Characteristics

Pasadena's weather is characterized as a Mediterranean climate (see Table 2-1). Temperatures are mild winter, spring and fall, and hot and dry during summer months. Water demand in the PWP service area increases in the summer months due to outdoor irrigation. Total precipitation in Pasadena averages about 20 inches per year and approximately 71 percent falls between January and March. Typically, August is the hottest months of the year with an average daily maximum temperature of 89 degrees Fahrenheit. Evapotranspiration follows a similar trend as temperature, peaking in July and decreasing in December.

Table 2-1. Climate Data

Month	Daily Maximum Temperature for Month[1] (°F)	Average of Daily Maximum Temperature for Month[1] (°F)	Monthly Average Precipitation[1] (in)	Monthly Average Evapotranspiration[2] (in)
January	80.95	66.74	4.31	1.59
February	82.63	68.41	4.61	2.20
March	83.79	70.46	3.22	3.66
April	88.93	73.96	1.45	5.08
May	92.23	76.85	0.37	6.83
June	94.59	81.76	0.15	7.80
July	98.51	88.63	0.02	8.67
August	99.68	89.48	0.10	7.81
September	101.33	87.53	0.36	5.67
October	96.57	81.17	0.68	4.03
November	87.35	73.96	1.81	2.13
December	81.64	67.77	3.00	1.59
Annual	90.68	77.23	20.09	57.06

[1] 1928-2008, Pasadena Weather Station, ID 6719
[2] Monrovia, Station ID. 159, www.cimis.water.ca.gov/cimis/welcome.jsp

2.4 Demographic Characteristics

Population and housing projections are tools utilized to project municipal and industrial water demands. Table 2-2 provides current and future population projections for PWP's service area from 2010 to 2035. These projections were provided by the Southern California Association of Governments (SCAG) and modified using MWD's land use planning tool to scale the data to PWP's service area. Growth will occur at a rate between 2-3 percent every five years from the 2010 population of 175,957 to reach a population of 199,562 in 2035, an increase of about 9,602 people. Housing units will increase from 64,272 units in 2010 to reach 73,874 units in 2035.

Table 2-2. Population and Housing Unit Forecast from 2010-2035

Year	Service Area Population[1]			Housing Units[1]		
	Population	Percent	Change	Housing Units	Percent	Change
2010	175,957	NA	NA	64,272	NA	NA
2015	180,691	2.69%	4,734	66,485	3.44%	2,213
2020	185,640	2.74%	4,949	68,830	3.53%	2,345
2025	190,436	2.58%	4,796	70,656	2.65%	1,826
2030	195,089	2.44%	4,653	72,415	2.49%	1,759
2035	199,562	2.29%	4,473	73,874	2.01%	1,459

NA: Not applicable
[1] Source: SCAG Regional Transportation Plan (2008), modified using MWD's land use planning to represent PWP's service area.

This page intentionally left blank.

Section 3
Water Demands

3.1 Law

California Water Code Section:

10631. A plan shall be adopted in accordance with this chapter and shall do all of the following:

10631 (e) (1) Quantify, to the extent records are available, past and current water use, over the same five-year increments described in subdivision (a), and projected water use, identifying the uses among water use sectors including, but not necessarily limited to, all of the following uses:

> (A) Single-family residential; (B) Multi-family; (C) Commercial; (D) Industrial; (E) Institutional and governmental; (F) Landscape; (G) Sales to other agencies; (H) Saline water intrusion barriers, groundwater recharge, or conjunctive use, or any combination thereof; and (I) Agricultural.

10631 (e) (2) The water use projections shall be in the same 5-year increments to 20 years or as far as data is available.

New Requirements for 2010 UWMPs

10608.20 (e) An urban retail water supplier shall include in its urban water management plan due in 2010 the baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the basis for determining those estimates, including references to supporting data.

10631.1 (a) The water use projections required by Section 10631 shall include projected water use for single-family and multi-family residential housing needed for lower income households, as defined in Section 50079.5 of the Health and Safety Code, as identified in the housing element of any city, county, or city and county in the service area of the supplier.

3.2 Service Area Demand

Water demand is the amount of water used by PWP's customers and in PWP's water system, which PWP will need to supply. In PWP's service area, there are four major categories of water demand.

- Single-Family – representing detached and attached individually metered residences;
- Multi-Family – representing apartments and condominiums that are master metered for the entire building or complex;

- Commercial/Institutional – representing businesses, government, academic, and research institutions which could be metered individually or master metered;

- Non-Revenue Water – representing water that is not billed to any customers and can include fire protection, system flushing, inaccurate metering, and distribution system losses.

Total past and current water demands for PWP are shown for various water use sectors in Table 3-1. Past water use is presented for 2005 and current water use for 2007. The year 2007 was used to derive an estimate of current water use by customer sector because there was no mandatory or drought-related conservation, but the year was current enough to account for programmatic and passive conservation that has already occurred. The total 2005 and 2007 water demands of 36,576 and 39,168 acre-feet per year (AFY), respectively, are the sums of metered and unaccounted-for water.

Table 3-1. Past (2005) and Current Water Deliveries (2007)

Water Use Sectors	Volume (AFY)	
	2005	2007
Single family	17,417	18,759
Multi-family	6,364	6,854
Commercial/Institutional	9,714	10,462
Total Consumption	33,495	36,075
Unmetered Demand	3,081	3,093
Total Treated Water Demand	36,576	39,168

In the past PWP did not track water use by customer sector, but rather only by meter size. As part of an evaluation of water rates, PWP initiated efforts in 2009 to determine water use by the following customer sectors: single-family, multi-family, and commercial/institutional. PWP was able to classify approximately 90% of the meters into the appropriate sector. The percentage of water use by customer sector determined for 2009 was applied to the total billed water use for 2005 and 2007 to develop approximate water use by sector for the respective years.

Unaccounted-for water is the difference between total water supply production and billed consumption. All water systems have some level of unaccounted-for water, typically ranging from 5-10 percent of total demand. Sources of unaccounted-for water in PWP's system may include losses from system leaks, meter inaccuracies, unmetered uses of water such as emergency uses of fire hydrants, or other unauthorized uses.

Projections of water demand for PWP were developed as part of the recently completed WIRP based on historical water use factors, projected demographics, and passive (or code-based) water conservation. A detailed description of the forecast methodology and assumptions are located in Section 3 and Appendix A of the WIRP. Projected water demands for 2015 to 2035 are presented in Table 3-2. Over the period from 2010 to 2035, PWP estimates an increase in water demand from 38,460 AFY to 43,380 AFY.

Table 3-2. Projected Water Demand for 2015 – 2035 (without future active water conservation)

Water Use Sectors	2015		2020		2025		2030		2035	
	# of Units[1]	Volume (AFY)[2]	# of Units[1]	Volume (AFY)[2]	# of Units[1]	Volume (AFY)[2]	# of Units[1]	Volume (AFY)[2]	# of Units[1]	Volume (AFY)[2]
Single family[3]	37,600	19,200	38,600	19,900	39,400	20,300	40,200	20,500	40,700	20,600
Multi-family[4]	28,900	6,800	30,200	7,200	31,200	7,500	32,300	7,600	33,200	7,700
Commercial/ Institutional[5]	129,000	10,800	131,600	11,100	134,700	11,300	137,900	11,500	141,000	11,600
Total	195,500	36,800	200,400	38,200	205,300	39,100	210,400	39,600	214,900	39,900
Unmetered Demand		3,200		3,300		3,400		3,400		3,400
Treated Water Demand		40,000		41,500		42,500		43,000		43,300

[1] Data obtained from Pasadena Water and Power *Water Integrated Resources Plan*, January 12, 2011, Appendix A, Table A-1.

[2] Water demands adjusted for recessional impacts through 2020 and passive conservation due to plumbing codes for new construction. Values rounded to the nearest hundred for each water use sector and unmetered demand.

[3] Single-family units are equivalent to the number of single-family water meters.

[4] Multi-family units are the number of multi-family homes within the service area. Multi-family water use declines in 2015 as compared to 2007 Current Water Use (Table 3-1) based on adjustments for California's plumbing codes, economic factors, and weather. Adjustment factors are provided in the *Water Integrated Resources Plan,* Appendix A.

[5] Commercial / Institutional units are number of employees within the service area.

3.3 Low-income Water Demand

New requirements for 2010 UWMPs include reporting the projected low-income customer water demand. Low income households are defined in the California Health and Safety Code Section 50079.5. The State establishes low income thresholds equivalent to the US Department of Housing and Urban Development's (HUD) 80 percent limit. Under the 80 percent limit, low-income households are classified as having an annual income not exceeding 80 percent of the area median household income, adjusted by the number of persons in the household. The 80 percent limit is a relative term and is not always equal to 80 percent of the area median household income as HUD makes adjustments for high housing costs and other factors.

To estimate the low-income water demand forecast, current and future low-income households need to be projected and multiplied by an assumed per household water use factor. Based on the Southern California Association of Government (SCAG) Regional Housing Needs Assessment (RHNA) Subcommittee's report titled ***Draft RHNA Methodology Framework***[1] approximately 36 percent of the City's total households were low-income. This percentage would also be applied to the rest of PWP's service area outside of the City's boundaries in order to obtain total service area low-income households. Further, it was assumed that this percentage would be constant throughout the projection period, and therefore multiplied by each forecast year's total PWP service area households to obtain future low-income households. Using this method, there were an estimated total of 23,138 low-income households in the service area in year 2010. It was assumed that 75 percent of these low-income households were single-family residences and 25 percent were multi-

[1] Southern California Association of Governments Report to Regional Housing Needs Assessment Subcommittee, April 19, 2011, "Attachment 1, Household Income Distribution by RHNA Income Category Based on County Median Household Income from American Community Survey 2005-2009 5-Year Average."

family residences. Based on the City's housing plan element, it is assumed that all new low-income households will be multi-family residences. These projections of low-income households were then multiplied by a per household water use factor that was assumed to be 30 percent lower than system average water use. Table 3-3 presents the current and projected water demands for low-income customers.

Table 3-3. Current and Projected Water Demands for Low-Income Customers

Type	Water Demand (AFY)					
	2010	2015	2020	2025	2030	2035
Single-family residential homes[(1)]	5,784	5,784	5,784	5,784	5,784	5,784
Single-family unit water use (gallons/day/home)[(2)]	300	300	300	300	300	300
Single-family water demand (AFY)	1,944	1,944	1,944	1,944	1,944	1,944
Multi-family residential homes[(1)]	17,354	18,151	18,995	19,652	20,285	20,811
Multi-family unit water use (gallons/day/home)[(2)]	150	150	150	150	150	150
Multi-family water demand (AFY)	2,916	3,050	3,192	3,302	3,408	3,497
Total low-income demand (AFY)	4,860	4,993	5,135	5,246	5,352	5,440

[(1)] Low income households are assumed to be 36 percent of the housing units within Table 2-2. The percentage is based on SCAG's Report to the Regional Housing Needs Assessment Subcommittee, April 19, 2011, "Attachment 1, Household Income Distribution by RHNA Income Category Based on County Median Household Income from American Community Survey 2005-2009 5-Year Average."

[(2)] Assumed to be 30 percent lower than system average household water use.

3.4 Water Conservation Bill Requirements

The Water Conservation Bill (Senate Bill 7) was developed to implement the 20x2020 Plan, which sets forth a statewide road map to maximize the state's urban water efficiency and conservation opportunities between 2009 and 2020, and beyond. It aims to set in motion a range of activities designed to achieve a 20 percent reduction in gross per capita urban water demand by 2020. Section 1060.12 (g) defines gross water use as the total volume of water, whether treated or untreated, entering the distribution system of an urban retail water supplier, excluding all of the following:

- Recycled water that is delivered within the service area of an urban retail water supplier or its urban wholesale water supplier;
- The net volume of water that the urban retail water supplier places into long-term storage;
- The volume of water the urban retail water supplier conveys for use by another urban water supplier;
- The volume of water delivered for agricultural use, except as otherwise provided in subdivision (f) of Section 10608.24; and

- Industrial process water, which may be exclude from the calculation of gross water use to avoid a disproportionate burden on another customer sector if it comprises a *substantial percentage* of industrial water use in its service area.

DWR has published guidelines describing how to determine the baseline gross per capita water demand for water purveyors throughout California. The guidelines allow for use of one of four alternatives to calculate the reduction in baseline per capita demand between baseline levels and 2020 needed to demonstrate compliance. Section 3.4.1 presents the computation of baseline per capita demand values for the PWP service area, and Section 3.4.2 presents interim and final targets. In addition, Section 3.4.3 estimates the effectiveness of water conservation BMPs implemented in recent years and the remaining demand reduction needed for PWP to reach the interim and final targets for per capita demand by 2015 and 2020, respectively.

3.4.1 Baseline Gross Per Capita Demand

Actual per capita water demand for PWP was determined for each calendar year from 1995 through 2010 as the total water demand (including unaccounted-for water) divided by the population. The baseline per capita water demand represents water use over a continuous multi-year base period. To account for year-to-year fluctuations in per capita water use, multi-year averages of annual per capita demand are used for both the baseline per capita demand, and minimum water use reduction requirement. Depending on the function, the two base periods are specified in the California Water Code, Sections 10608.20 and 10608.22, as follows:

- For the baseline per capita demand, if recycled water made up 10 percent or more of 2008 retail water delivery, use a continuous 10- to 15-year period ending no earlier than December 31, 2004, and no later than December 31, 2010. Otherwise, only a continuous 10-year period can be used to set the baseline per capita demand

- For the minimum water use reduction requirement, it is necessary to compute per capita demand over a continuous five-year base period ending no earlier than December 31, 2007, and no later than December 31, 2010. The urban water use target is not to exceed 95 percent of the per capita demand over this base period.

PWP, as of 2010, does not use recycled water to serve 10 percent of water deliveries; therefore, a continuous 10-year period was used as the baseline per capita demand. The averages of per capita demand over the evaluated base periods provided a basis for selecting a baseline per capita demand of 210 gallons per person per day (gpcd), as shown in Table 3-4. PWP selected the maximum value of the base period averages, which occurred for the period of 1995-2004, to represent the baseline per capita demand.

Water Code Section 10608.22 specifies a minimum water use reduction requirement for 2020. This requirement states the baseline per capita demand in 2010 must be reduced by at least a minimum amount, unless the five-year base period average is less than 100 gpcd. The minimum water use reduction requirement for the PWP service area equals 192 gpcd as computed in Table 3-5. If the 2020 per capita water demand targets computed using the methods described below (Section 3.4.2) are greater than 192 gpcd, then this value must be used.

Table 3-4. Computation of Baseline Per Capita Water Demand for the PWP Service Area

Year	Service Area Population [1]	Annual Demand (AFY)[2]	Annual Per Capita Demand (GPCD)	10-Year Average Per Capita Demand (GPCD) [3]
1995	149,872	32,806	195	NA
1996	149,992	37,140	221	NA
1997	151,273	38,126	225	NA
1998	152,598	35,181	206	NA
1999	154,719	38,016	219	NA
2000	157,742	39,494	224	NA
2001	160,508	33,122	184	NA
2002	163,233	38,909	213	NA
2003	165,511	37,942	205	NA
2004	167,286	39,079	209	210
2005	168,555	36,576	194	210
2006	169,504	37,753	199	208
2007	170,392	39,168	205	206
2008	171,289	37,175	194	204
2009	172,528	32,800	170	200
2010	175,957	29,534	150	192
Baseline Per Capita Demand (maximum of multi-year average per capita demand)				**210**

[1] Includes City of Pasadena and portions of the following unincorporated areas: Altadena, East Pasadena, and San Gabriel.
[2] Demands include unaccounted water. Unaccounted water is the difference between production and metered consumption.
[3] Ten-year averages of per capita demand for setting PWP's baseline per capita demand cannot end earlier than 2004 or later than 2010.

Table 3-5. Computation of Minimum Water Use Reduction Target for the PWP Service Area

Year	Population	Annual Demand (AFY)	Annual Per Capita Demand (GPCD)	5-Year Average Per Capita Demand (GPCD) [1]
2003	165,511	37,942	205	n/a
2004	167,286	39,079	209	n/a
2005	168,555	36,576	194	n/a
2006	169,504	37,753	199	n/a
2007	170,392	39,168	205	202
2008	171,289	37,175	194	200
2009	172,528	32,800	170	192
2010	175,957	29,534	150	184
Minimum Water Use Reduction Requirement (0.95 x max five-year average per capita water demand)				**192**

[1] Five year average of per capita water demand for setting the minimum water use reduction requirement cannot end earlier than 2007 or later than 2010.

3.4.2 Urban Water Use Target

The urban water use target is the per capita demand that would result in compliance with the requirements of the Water Conservation Bill. PWP's per capita demand in 2020 must be reduced to the urban water use target to demonstrate compliance. In addition, development of an interim urban water use target, equal to half the 2020 urban water use target, is required.

DWR provides four alternative methods to compute the urban water use target for a water supplier. The first method is to reduce the baseline per capita demand by 20 percent, which is consistent with the statewide goal of 20 percent reduction in per capita urban water use demand by 2020. The other three methods estimate a less aggressive demand reduction appropriate for agencies that have a high proportion of commercial, industrial, or institutional demand forecasted, or if current water demand indicates high levels of water conservation and/or recycling. Detailed guidance on implementing each method is included in DWR's "Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use." The methods are briefly summarized below:

- **Method 1:** Eighty percent of the water supplier's baseline per capita demand.
- **Method 2:** Per capita daily water use estimated using the sum of performance standards applied to indoor residential use; landscaped area water use; and commercial, industrial, and institutional uses.
- **Method 3:** Ninety-five percent of the applicable state hydrologic region target as stated in the State's April 30, 2009, Draft 20x2020 Water Conservation Plan.
- **Method 4:** Calculates water demand savings through implementation of the following best management practices (BMPs): retrofits of inefficient indoor residential fixtures, such as toilets, washers, and showers; increased efficiency in the commercial, industrial, and institutional accounts; and conversion of unmetered connections to metered connections. The target represents the water demand if the BMPs are implemented within the service area at saturation levels.

PWP selected Method 1 to compute its urban water use target per capita demand. Thus, the baseline per capita demand of 210 gpcd must be reduced by 20 percent to 168 gpcd by 2020. The interim target for 2015 is 189 gpcd. Method 1 was selected because the data collection effort necessary to determine values for use in Methods 2 and 4 is prohibitive. Method 3 yielded a much lower target of 142 gpcd that would require a reduction in urban water use by over 40 percent.

3.4.3 Method for Demonstrating Compliance with the Water Conservation Bill Requirements

PWP will demonstrate compliance if the per capita demand during the final year of the 2010-2015 and 2016-2020 reporting periods is less than or equal to the interim and final urban water use targets. Compliance assessments will be reported in PWP's 2015 and 2020 UWMPs. If the 2015 UWMP shows that the interim water use target is not achieved, adjustments will be made to its water conservation plan to achieve the 2020 urban water use target.

PWP estimated recent per capita demand to determine how effective current demand management measures (DMMs) have been towards reducing the per capita demand from average levels over the 1995 – 2004 base period. Average urban per capita water use over the 2006 to 2008 period was 199 gpcd, which equates to a five percent reduction from the baseline per capita demand. Urban water use in 2009 and

2010 was not used to assess current consumption patterns due to the economic downturn, which has resulted in atypical water use across the service area.

The reduction in demand necessary to lower the current per capita demand to the interim and final urban water use targets is shown in Table 3-6. Included in Table 3-6 is PWP's approach to achieving the required reduction in gpcd using a combination of recycled water and additional water conservation measures, such as:.

- Ensuring correct application of more stringent design standards related to indoor and outdoor water use for new development projects (e.g. Statewide Model Water Efficient Landscape Ordinance);
- Enforcement of prohibited water uses during Stage 1 per the Emergency Water Conservation ordinance (see Section 5.5);
- Enhancement of DMM implementation (see Section 6); and/or
- Implementation of additional water conservation BMPs (see Section 3.5).

Table 3-6. Computation of Demand Reduction Needed to Comply with Urban Water Use Target

Planning Year	Projected Service Area Population	Projected Water Demand without New Conservation (AFY)[1]	Projected Per Capita Demand without New Conservation (GPCD)	Urban Water Use Target (GPCD)	Projected Water Demand in Excess of Target (AFY)	Planned Recycled Water Use [2] (AFY)	Planned Water Conservation [3] (AFY)	Urban Per Capita Use with Planned Recycled & Conservation (GPCD)
2015	180,691	39,940	197	189	1,740	730	2,500	181
2020	185,640	41,510	200	168	6,550	1,650	5,000	168
2025	190,436	42,490	199	168	6,650	1,650	5,980	163
2030	195,089	43,010	197	168	6,280	1,650	6,500	160
2035	199,562	43,380	194	168	5,740	1,650	6,870	156

[1] Unrounded water use sector demand data and unmetered demand data used in development of Table 3-2 was summed and rounded to the nearest ten to obtain projected water demand without active conservation and determine projected water demand in excess of the interim 2015 target and 2020 target.

[2] Planned recycled water use does not include 400 AFY associated with non-potable tunnel water available for each planning year.

[3] PWP's WIRP identified an aggressive water conservation plan which could save up to 9,000 AFY. If planned water conservation is not sufficient to achieve the urban water use target or if planned recycled water is not fully implemented, then PWP will implement additional components of the aggressive water conservation plan.

3.5 Water Conservation BMP Implementation

Implementation of additional water conservation BMPs in addition to current conservation efforts will assist PWP in achieving its interim and final urban water use targets. Existing BMPs are discussed in Section 6, Water Demand Management Measures. The recently completed WIRP identified varying methods to achieve PWP's conservation goals. The WIRP calls for aggressive conservation to achieve the goal of 9,000 AFY of new conservation savings by 2035. As shown in Table 3-6, if additional conservation can offset water demand by 5,000 AFY by 2020, then PWP is expected to meet its urban water use target and demonstrate compliance with the 2009 Water Conservation Bill. PWP continues to evaluate conservation

BMP elements for implementation. Potential examples of conservation BMP elements under consideration and discussed in the WIRP include:

- Convert about 70 percent of existing single family homes to comply with the California Model Landscape Ordinance (requires a combination of irrigation efficiency measures and turf replacement to warm season grass) – through PWP rebates and rate structure enhancements, estimated savings of 1,630 AFY by 2035
- Require that all new single family homes shall have drought tolerant landscaped front yards, and warm season lawn (model landscape compliant) back yards – through ordinances for new development and PWP rebates, estimated savings of 540 AFY by 2035
- Convert 60-70 percent of existing multi-family and commercial landscapes to comply with California Model Landscape Ordinance – through PWP rebates and rate structure enhancements, estimated savings of 1,600 AFY by 2035
- Double the implementation of PWP's current indoor conservation for single-family customers – through PWP rebates and ordinances for plumbing retrofits on resale of property, estimated savings of 2,980 AFY by 2035
- Continue PWP's current indoor conservation for multi-family and commercial customers – through PWP rebates, estimated savings of 2,100 AFY by 2035
- Install individual meters for all new multi-family accounts – through ordinance, estimated savings of 240 AFY by 2035.

Average annual costs to PWP were developed in the WIRP based on planning level assumptions. These costs, in 2010 dollars, are forecasted to be approximately $2.16 million. Actual annual costs will vary as additional detailed studies will be required before implementation resulting in refined cost estimates. Overtime these costs may also vary depending on the effectiveness of each conservation measure that is implemented. A portion of the costs may be offset by MWD's conservation credits programs and/or grant funding.

The WIRP recommends a phased approach for implementation to account for variables, such as lower than forecast water demands or continued reduction in water consumption related to pricing and public education. These variables may ultimately allow PWP to meet the interim and final urban water use 20x2020 targets and PWP's conservation targets with a reduced investment. As recommended by the WIRP, phasing for the 2010 to 2015 time frame is as follows:

- Implement a rate structure that allows PWP to increase fixed revenue sources and explore ways to increase cost fairness related to how customers use water, while still providing a water conservation signal.
- Continue to implement programmatic conservation measures at similar levels as in the past.
- Consider a stewardship charge on all water sold to help pay for conservation measures and ensure that any charges comply with Propositions 218 and 26.

- Develop and implement ordinances for new development and resale that requires:
    - Landscaping to be compliant with California Model Landscape requirements for all new residential and commercial properties(PWP adopted this in July 2010);
    - Individual meters for all new multi-family developments; and
    - Plumbing retrofits on resale of residential and commercial properties.

After 2015, PWP will use review its conservation program every five years using an adaptive management approach to determine if more aggressive conservation needs to be implemented. Figure 3-1 presents the adaptive management strategy for water conservation.

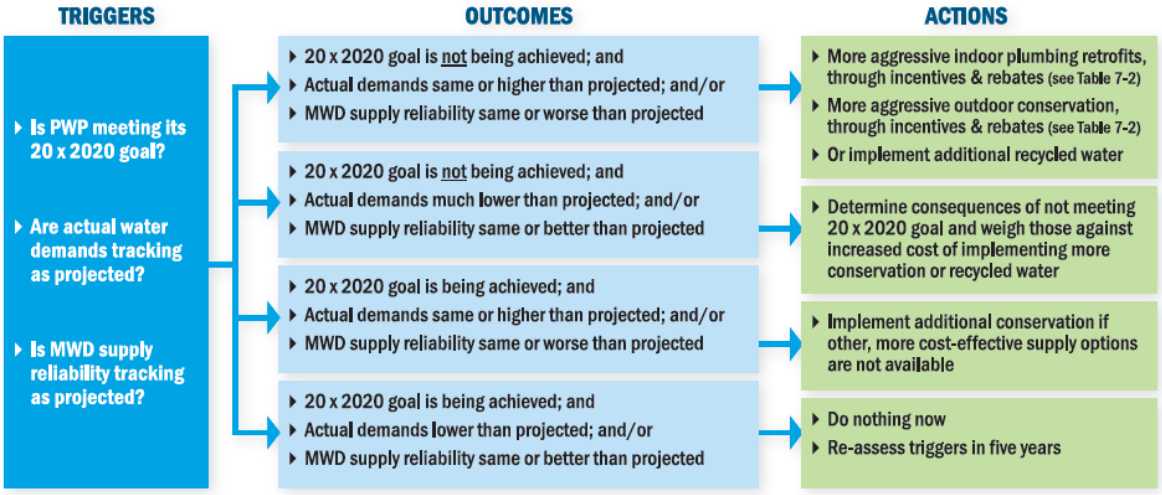

Figure 3-1. Adaptive Strategy for Conservation

Section 4
Water Supply Sources

4.1 Law

California Water Code Section:

10631. A plan shall be adopted in accordance with this chapter and shall do all of the following:

10631 (b) Identify and quantify, to the extent practicable, the existing and planned sources of water available to the supplier over the same five-year increments as described in subdivision (a). If groundwater is identified as an existing or planned source of water available to the supplier, all of the following information shall be included in the plan:

10631(b) (1) A copy of any groundwater management plan adopted by the urban water supplier, including any specific authorization for groundwater management.

10631(b) (2) A description of any groundwater basin or basins from which the urban water supplier pumps groundwater. For those basins for which a court or the board has adjudicated the rights to pump groundwater, a copy of the order or decree adopted by the court or the board and a description of the amount of groundwater the urban water supplier has the legal right to pump under the order or decree. For basins that have not been adjudicated, information as to whether the department has identified the basin or basins as over drafted or has projected that the basin will become over drafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition.

10631(b) (3) A detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

10631(b) (4) A detailed description and analysis of the amount and location of groundwater that is projected to be pumped by the urban water supplier. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

10631 (d) Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.

10631 (h) Include a description of all water supply projects and water supply programs that may be undertaken by the urban water supplier to meet the total projected water use as established pursuant to subdivision (a) of Section 10635. The urban water supplier shall include a detailed description of expected future projects and programs, other than the demand management programs identified pursuant to paragraph (1) of subdivision (f), that the urban water supplier may implement to increase the amount of the water supply available to the urban water supplier in average, single-dry, and multiple-dry water years. The description shall identify specific projects and include a description of the increase in water supply that is expected to be available from each project. The description shall include an estimate with regard to the implementation timeline for each project or program.

10631 (i) Describe the opportunities for development of desalinated water, including, but not limited to, ocean water, brackish water, and groundwater, as a long-term supply.

10631 (k) Provide documentation that either the retail agency provided the wholesale agency with water use projections for at least 20 years, if the UWMP agency is a retail agency, OR, if a wholesale agency, it provided its urban retail customers with future planned and existing water source available to it from the wholesale agency during the required water-year types.

10633. The plan shall provide, to the extent available, information on recycled water and its potential for use as a water source in the service area of the urban water supplier. The preparation of the plan shall be coordinated with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area, and shall include all of the following:

10633 (a) A description of the wastewater collection and treatment systems in the supplier's service area, including a quantification of the amount of wastewater collected and treated and the methods of wastewater disposal.

10633 (b) A description of the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.

10633 (c) A description of the recycled water currently being used in the supplier's service area, including, but not limited to, the type, place, and quantity of use.

10633 (d) A description and quantification of the potential uses of recycled water, including, but not limited to, agricultural irrigation, landscape irrigation, wildlife habitat enhancement, wetlands, industrial reuse, groundwater recharge, and other appropriate uses, and a determination with regard to the technical and economic feasibility of serving those uses.

10633 (e) The projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected pursuant to this subdivision.

10633 (f) A description of actions, including financial incentives, which may be taken to encourage the use of recycled water, and the projected results of these actions in terms of acre-feet of recycled water used per year.

10633 (g) A plan for optimizing the use of recycled water in the supplier's service area, including actions to facilitate the installation of dual distribution systems, to promote recirculating uses, to facilitate the increased use of treated wastewater that meets recycled water standards, and to overcome any obstacles to achieving that increased use.

10634. The plan shall include information, to the extent practicable, relating to the quality of existing sources of water available to the supplier over the same five year increments as described in subdivision (a) of Section 10631, and the manner in which water quality affects water management strategies and supply reliability.

4.2 Introduction

PWP's water supply consists of three sources with an additional three sources planned over the 2035 timeframe. Currents sources are groundwater, surface supplies, and imported water purchases from MWD. Planned sources are recycled water in 2015, Devil's Gate surface diversion in 2015, and a groundwater storage program using MWD replenishment water which will be implemented as needed. Current water supplies and planned water supplies are discussed in this section.

4.3 Groundwater

4.3.1 Raymond Basin Description

Raymond Basin is an alluvial valley approximately 40 square miles in area underlain by deposits of gravel, sand, silt, and clay. The basin is located in the northwest portion of the San Gabriel Valley in Los Angeles County, California, and bounded by the San Gabriel Mountains to the north, the San Rafael Hills to the west, and the Raymond Fault to the south/southeast. Raymond Basin is divided into three subareas: the Monk Hill subarea in the northwest, the Pasadena subarea in the central portion of the basin, and the Santa Anita subarea in the east.

The base of the water-bearing strata of the Raymond Basin is defined by bedrock material that is not considered to yield significant quantities of water. Overlying the bedrock are more than 1,200 feet (ft) of unconsolidated alluvial materials consisting of boulders, gravel, sand, silt, and clay. This alluvium is the principal water-bearing unit in the Raymond Basin. Well yields in the alluvium range from a few hundred to several thousand gallons per minute (gpm). The alluvial aquifer system in the Raymond Basin consists of many individual interconnected water-bearing zones.

Specific yield values in the Raymond Basin are typical of alluvial sediments and range from approximately 5 to 18 percent. Groundwater generally flows southerly from areas of recharge at the base of the San Gabriel Mountains to areas of discharge along Raymond Fault at hydraulic gradients ranging from approximately 0.040 to 0.090 ft/ft. The Raymond Fault acts as a leaky hydrologic barrier and defines the boundary between the Raymond Groundwater Basin and the main San Gabriel Valley Groundwater Basin to the south. In general, groundwater levels are relatively higher in the northern half of the basin and lower in the southern half than they were historically.

Groundwater discharge in the Raymond Basin occurs through pumping and subsurface outflow across the Raymond Fault. Current sources of groundwater recharge to the Raymond Basin include:

- Natural infiltration and percolation of rainfall and surface water
- Percolation of applied water from irrigation, other return flows, and cesspools

- Subsurface inflow from adjacent groundwater basins, bedrock areas, and the San Gabriel Mountains
- Artificial recharge through surface water spreading
- Percolation of water from septic tanks.

4.3.2 Raymond Basin Judgment

PWP currently utilizes two local water supplies within the Raymond Basin: groundwater, which is pumped directly into the distribution system; and surface water, which is diverted and spread for groundwater pumping credits. The Raymond Basin Judgment details PWP's groundwater extraction and surface water diversion rights and is included in Appendix D.

In order to alleviate overdraft conditions in the Raymond Basin, the Raymond Basin Judgment was signed on December 23, 1944. The Judgment assigns each pumper a "present unadjusted right" corresponding to the average amount of water that they pumped in the five years prior to 1937. Pasadena's present unadjusted right was 12,946 acre-ft/year. Each pumper's present unadjusted right was scaled down to create the "decreed right" such that the sum of all pumpers' decreed rights is equal to the estimated operating yield of the basin. In the original Judgment, the operating yield was determined to be 21,900 AFY for the entire Raymond Basin. However, according to the first modification of the Judgment in 1955, the operating yield was increased to 5,290 AFY in the Eastern Unit and 25,480 AFY in the Western Unit. This resulted in a total operating yield of 30,770 AFY in the Raymond Basin. Therefore, the sum of all water that is pumped—excluding water pumped from individual storage accounts or as a result of spreading or injection credits—is regulated so as not to exceed the total operating yield of the basin. Based on the new operating yield, PWP's decreed right was calculated to be 12,807 AFY from the Western Unit (Monk Hill and Pasadena subareas); PWP has no water right in the Eastern Unit (Santa Anita subarea). In 2009, the Raymond Basin Management Board (RBMB) implemented a resolution to the 1955 decreed rights to slow declining water levels in the Western Unit of Raymond Basin. The resolution is included in Appendix E. This resolution called for a cooperative pumping reduction for parties with water rights in the Pasadena subarea effective July 1, 2009, where RBMB seeks to reduce water production incrementally over five years until a 30% reduction is achieved. Hence, PWP's water right will be decreased by 2,503 AF over 5 years to a final right of 10,304 AFY. In 2010 PWP's right was 12,056 AF.

4.3.3 Surface Runoff Spreading Credits

In addition to operating yield pumping, a 1974 modification to the Raymond Basin Judgment allowed for each pumper with surface runoff diversion rights to recharge the Raymond Basin using injection wells or spreading grounds and then pump a portion of the water diverted from any well. The ability to spread surface runoff provides benefits of natural water treatment and storage of water diverted during the wet season for use in periods of higher demand. Diversion of surface runoff for groundwater recharge is discussed further in Section 4.4, which describes PWP's current use of surface runoff diversion from Arroyo Seco and Eaton Wash and future plans for maximizing use of this local source of supply. Pumping credits from spreading of diverted surface runoff provided an average of 2,380 AFY of additional groundwater over the 1999-2009 period, ranging from approximately 1,000 to 6,000 AFY in dry and wet years. Appendix F provides the methodology for calculating spreading credits as prepared by the RBMB.

4.3.4 Groundwater Production

Over the past five years, groundwater production by PWP has averaged approximately 12,000 AFY (Table 4-1). Over the same period, the combination of groundwater rights and pumping credits from surface runoff spreading has averaged approximately 14,000 AFY.

Table 4-1. Recent Groundwater Production from PWP's Raymond Basin Wells in Acre-Feet

Well Name	2006	2007	2008	2009	2010
Monk Hill Subarea					
Well 52 [(1)]	-	-	-	-	-
Arroyo (25) [(1)]	-	-	-	-	-
Ventura (21) [(1)]	-	-	-	-	-
Windsor (48) [(1)]	-	-	-	-	-
Pasadena Subarea					
Bangham (57)	5	407	2,357	2,028	757
Chapman (49)	1,334	1,650	592	1	0
Copelin (3)	-	4	299	1,692	663
Craig (22)	1,126	385	-	0	0
Garfield (12)	2,249	922	7	7	6
Jourdan (26)	-	-	-	-	-
Monte Vista (15)	1,454	1,227	841	0	-
Sunset (20)	4	6	401	7	5
Villa (23)	-	1,675	0	479	1,654
Twombly (58)	3,264	3,089	3,249	3,258	3,054
Wadsworth (59)	2,054	2,070	2,178	2,146	1,997
Woodbury (10)	2,245	2,228	1,751	2,248	2,309
Raymond Basin Total	13,739	13,664	11,674	11,867	10,447

[(1)] Treatment system for perchlorate is on-line for production from the Monk Hill subarea in 2011

With the completion of the Monk Hill Treatment System (MHTS) discussed in 4.3.6 below, PWP's current pumping capacity is 37.1 cfs or 26,800 AFY (Table 4-2). This capacity is sufficient to pump the post 2014 operating rights of 10,304 AFY, plus an additional 6,000 AFY to extract surface runoff spreading credits in a wet hydrologic year. Figure 4-1 indicates PWP's general well locations in the basin.

4.3.5 Long-Term Storage

Groundwater supply reliability is further increased by PWP's long term storage accounts within the Raymond Basin. In 1992 and 1993, long term storage policies were adopted within the Raymond Basin. The basin storage capacity was determined and a storage volume of 96,500 AF was allocated to the Raymond Basin pumpers. PWP's share of the storage volume is 38,500 acre-ft. Additionally, PWP leases storage volume from other cities/agencies within the Raymond Basin. PWP's storage account is currently at 33,939 acre-feet.

Table 4-2. Summary of PWP's Existing Wells Status and Capacity

Well Name	Installation Year [1]	Last Year Rehabilitated [2]	Status	Extraction Capacity [2] (cfs)	Maximum Annual Production [6] (AFY)	Injection Capacity [7] (AFY)
Monk Hill Subarea						
Arroyo	1930	2010	Online[3]	4.9	3,547	-
Ventura	1924	2010	Online[3]	3.3	2,389	-
Well 52	1977	2010	Online[3]	4	2,896	-
Windsor	1969	2010	Online[3]	3.1	2,244	-
Pasadena Subarea						
Bangham	1993	-	Blending[4]	3.3	2,389	1,530
Chapman	1967	2003	Intermittent [5]	2.2	1,593	-
Copelin	1921	2008	Blending[4]	2.5	1,810	-
Craig	1924	2004	Offline[5]	1.6	1,158	-
Garfield	1921	2007	Blending [4]	3.1	2,244	1,155
Jourdan	1926	1993	Offline[5]	3.6	2,606	3,805
Monte Vista	1925	2006	Offline[5]	2.7	1,955	-
Sunset	1924	1997	Blending [4]	2.9	2,100	-
Twombly (#58)	1999	-	Online[5]	4.5	3,258	1,701
Villa	1925	2008	Blending[4]	5.1	3,692	-
Wadsworth (#59)	1998	2010	Online[5]	3.1	2,244	1,376
Woodbury	1930	1992	Online	3.3	2,389	-
			Total for currently online wells	26.2	18,967	5,762
			Total	53.2	38,500	9,567

[1] Source: 2004 Baseline Groundwater Assessment of the Raymond Basin (Geoscience)
[2] Source: PWP Staff, June 2010
[3] Well treated at Monk Hill Treatment System
[4] Well planned for treatment or blending at Sunset Treatment Plant and Reservoir
[5] Well planned for blending and chloramination at the Jones Reservoir via the Eastside Well Collector project
[6] Assuming continuous year-round operation of all wells
[7] Source: 2007 Pasadena Groundwater Storage Program Conceptual Design Report (RMC)

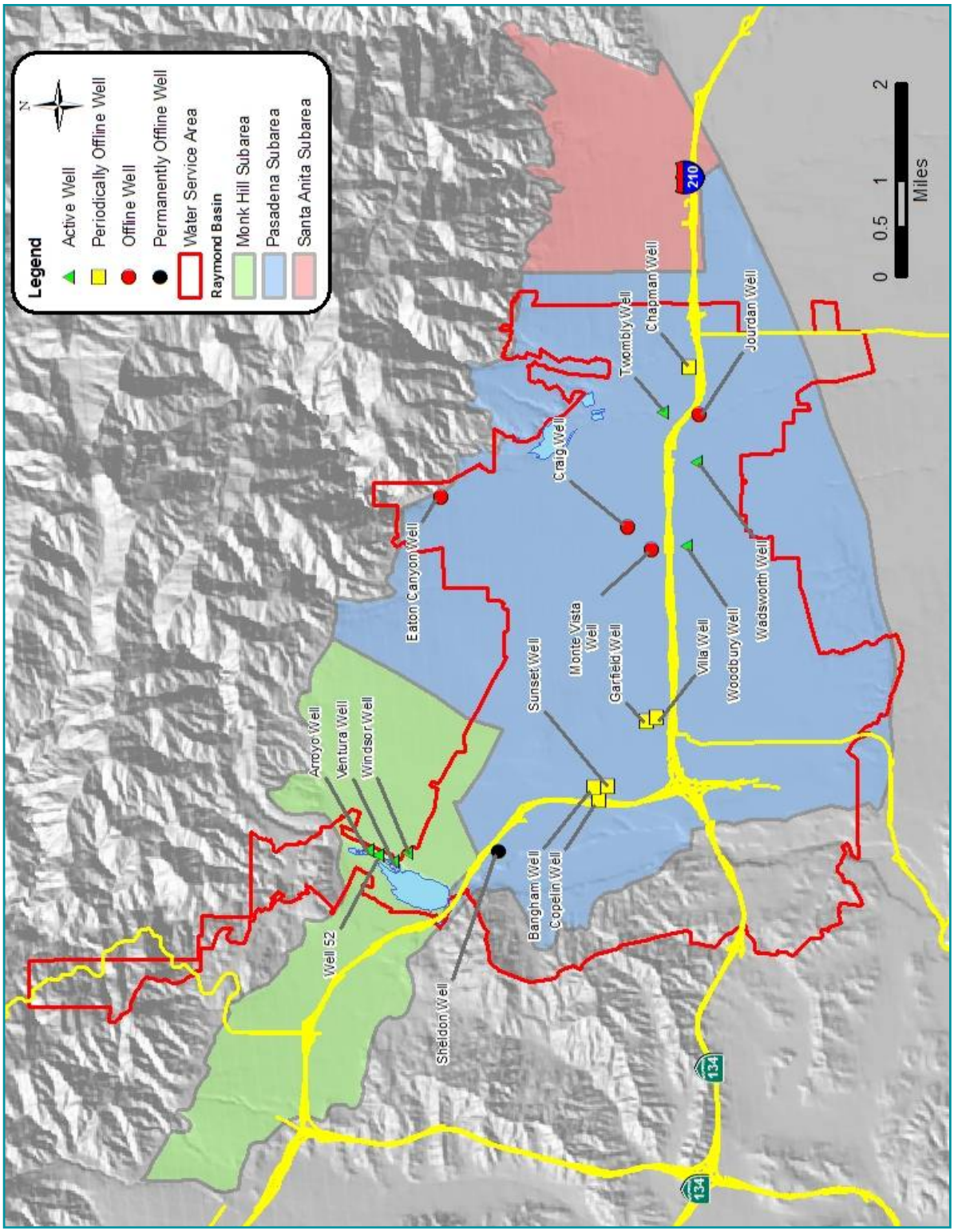

Figure 4-1. PWP Wells in Raymond Groundwater Basin

4.3.6 Groundwater Quality

Water quality and operational challenges at many of PWP's wells are responsible for underproduction of the combined operating yield rights and spreading credits in recent years. Although water quality issues have been discovered at individual wells, PWP uses a combination of removing wells from service, blending, and treatment to ensure water delivered to customers does not exceed the Maximum Contaminant Levels (MCLs) established by the California Department of Public Health (CDPH) and United States Environmental Protection Agency. Water quality issues identified at the wells include perchlorate, volatile organic compounds, nitrates, 1,2,3,-trichloropropane, and radionuclides. PWP recently completed the MHTS and is planning the Sunset Treatment Plant and Eastside Well Collector Project to ensure groundwater reliability.

Monk Hill Treatment System

In the Monk Hill subarea, concentrations of perchlorate, carbon tetra-chloride (CTC), and several other contaminants resulted in shut down of four of PWP's wells between 1997 and 2002, namely Arroyo, Well 52, Ventura, and Windsor. The source of the contamination is the NASA Jet Propulsion Laboratory (JPL) as shown by measurements of groundwater beneath JPL. PWP's design for the Monk Hill Treatment System (MHTS) for groundwater from these wells used influent concentration estimates based on 1997-2002 data for flow and concentrations from the impacted wells (flow-weighted concentrations of 37 ug/l perchlorate and 2 ug/l CTC). Prior to CDPH permitting of the MHTS, updated groundwater quality measurements in December 2010 through February 2011 were obtained from the impacted wells, which showed that contaminant concentrations have decreased since the shutdown of the wells (sample concentrations ranging from 5-45 ug/l perchlorate and non-detect for CTC). This decrease may be partially due to NASA's remediation efforts at the JPL over the past ten years.

In March of 2011, the 7,000 gpm MHTS was brought on-line to treat groundwater from the Arroyo Well, Well 52, Ventura Well, and Windsor Well in the Monk Hill subarea of the Raymond groundwater basin. The treatment technology used at the MHTS includes removal of perchlorate using single use ion exchange resin and absorption of organic chemicals using liquid phase granular activated carbon (LGAC). The same type of equipment has been successfully used since July 2004 at the Lincoln Avenue Water System on water that is also drawn from the Monk Hill sub basin, downgradient of PWP's four Monk Hill wells, also for the removal of CTC and perchlorate.

With the recent completion of the MHTS, PWP's pumping capacity has increased by 15.3 cfs as a result of the four newly activated groundwater production wells. This project will allow PWP to maximize use of its operating yield rights and surface runoff spreading credits.

Sunset Treatment Plant

PWP proposes to install an ion exchange perchlorate treatment system (IX system), a booster station, a chloramination system, and piping at the PWP's Sunset Reservoir site. The proposed IX system will be designed to remove perchlorate contamination from groundwater produced from either PWP's Copelin Well or Sunset Well. Copelin operates at approximately 1,100 gallons per minute (gpm) and Sunset at 1,200 gpm. To meet water demands, PWP also proposes blending treated water with 1 to 3 additional untreated wells (Garfield, Villa, and Bangham) exhibiting perchlorate levels typically below the MCL. The number of wells operating at any one time depends on a number of factors such as time of year (i.e. more wells operating during the summer than winter), wells requiring service, current levels of perchlorate, available

groundwater supply, and the desire to rebound groundwater levels in certain regions of the sub-basin. The design of the IX system accounts for the full build out at 2,300 gpm to treat both Copelin and Sunset in anticipation of future increases in the levels of perchlorate and/or due to stricter regulatory compliance.

Eastside Well Collector Project

PWP is planning to complete the Eastside Well Collector project, which would involve new raw water conveyance to blend production from seven PWP wells (Chapman, Craig, Jourdan, Monte Vista, Well No. 58, Well No. 59, and Woodbury). Groundwater from the Pasadena subarea pumped from these wells will flow directly into the existing Jones Reservoir, where a new chloramination facility will provide centralized groundwater disinfection prior to introduction into the distribution system. Figure 4-2 shows an approximate alignment for the Eastside Well Collector project, as recommended in the 2002 Water Master Plan. This project would increase PWP's groundwater pumping capacity by addressing entrained air issues and need for chloramination in several of the wells, but would not provide new water supply yield. Increasing pumping capacity provides additional flexibility in PWP operations to support planned increases in yields from recharge of surface runoff diversion and stormwater harvesting supplies and to meet demands with groundwater sources.

Once these projects are complete, PWP will have 16 wells with a combined pumping capacity of 53.2 cfs or 38,500 AFY. Offline wells in PWP's system are planned for repair, blending, or treatment to provide additional pumping capacity and may be used for the following:

- Reserve pumping capacity during short term shut downs of other wells.
- Extraction of water from the long-term storage account.
- Additional pumping capacity needed to support planned increases in yields from recharge of surface runoff diversion, stormwater harvesting, and imported water supplies.
- Use of pumping from different areas of the groundwater basin to stabilize water levels.

4.4 Surface Runoff

4.4.1 Water Diversion Rights

Surface runoff from the San Gabriel Mountains is a water supply source for PWP. PWP owns water rights to divert instantaneous runoff from Arroyo Seco up to 25 cfs and Eaton Canyon up to 8.9 cfs. The full amount of water available from PWP's diversion rights are not typically realized due to water quality issues, capacity limitations of PWP's existing facilities, as well, as discounts for groundwater recharge taken when applying the RBMB spreading credit methodology.

Runoff in the Arroyo Seco ranges drastically and is most dependent upon climatic patterns. In wet years, such as 2004-2005, annual runoff can exceed 40,000 AFY, most of which is lost to the Pacific Ocean via the Los Angeles River. Conversely, in dry years such as 2003-2004, runoff is limited to less than 1,500 AFY. In addition to year-to-year variation, runoff in Arroyo Seco is highly seasonal. In the dry season, runoff is typically an order of magnitude below PWP's diversion rights. On average, current operations yield approximately 2,500 AFY of PWP recharge in the Arroyo Seco Spreading Grounds, which produces approximately 1,500 AFY of PWP supply yield after RBMB credits are applied. Comparing historical surface

runoff to existing spreading indicates that approximately 1,000 AFY of PWP's water rights is underutilized. The WIRP evaluated several options to maximize use of this water source, but none were selected for inclusion in the long-term supply plan.

Flow data was not available for Eaton Canyon at PWP's diversion point. RBMB uses a spreading credit formula that is based on metered outflows from Eaton Reservoir and flow downstream of the Eaton Canyon spreading basins. Over the past 10 years, PWP spreading credits obtained from Eaton Wash rights have averaged approximately 880 AFY, ranging from 300 AFY in 2003-2004 to 1,850 AFY in 2004-2005. Spreading basins in Eaton Canyon are owned and operated by the Los Angeles County Department of Public Works (LACDPW). Hydrologic assessment of Eaton Canyon watershed and long-term average spreading credits obtained showed little opportunity to increase yield from this source of supply. On the other hand, the Eaton Canyon spreading basins have the potential to provide additional storage and recharge capacity for other local surface runoff sources, as discussed in the following section.

Water Quality

A recent forest fire in the upper Arroyo Seco watershed has degraded water quality in the Arroyo Seco near the existing diversion structure and at the spreading basins. During rain events, sediment and debris have clogged the intake structure and have reduced infiltration in the spreading basins as there is no dam located upstream of the intake structure to capture debris and sediment. PWP's diversion structure was designed to fully capture PWP's surface water right of 25 cfs. However, prior to the fire the current capacity was estimated at 18 cfs. As a result of the fire, PWP has stopped spreading operations on the Arroyo Seco until sediment and debris levels decline. If a similar event occurs in the future, PWP's water supply portfolio will be able to maintain reliability as a result of the WIRP planning process to maximize resources and increase conservation.

Spreading operations in Eaton Canyon are not as susceptible to fires as Eaton Dam is located upstream of the diversion intake structure. Most of the debris and sedimentation is captured at the dam and does not reduce diversion.

4.4.2 Devils Gate Storage to Eaton Canyon Project

Arroyo Seco runoff not diverted for recharge in the Arroyo Seco spreading grounds (under PWP and Lincoln Avenue Water Company water rights) flows to Devil's Gate Reservoir. In addition, most of the stormwater runoff from the City of La Canada Flintridge is routed to Flint Wash, which flows eastward to Devil's Gate Reservoir. There are no existing facilities to divert the water reaching Devil's Gate Reservoir to designated groundwater replenishment areas. Under current operating conditions, this runoff flows through Devil's Gate Dam to the Los Angeles River and ultimately to the Pacific Ocean.

The LACDPW Conservation Planning Section is currently designing a conservation project to store and divert water from Devil's Gate Reservoir to the Eaton Canyon spreading basins (which are owned and operated by LACDPW) for groundwater replenishment. Water from Devil's Gate Reservoir would be pumped via a new pump station and 30-inch pipeline to Eaton Canyon Reservoir, where it is then released to spreading basins (Figure 4-2). PWP plans to participate in the project funding and receive credit for a portion of the water recharged. PWP is also planning to use this pipeline to convey tertiary treated recycled water to Eaton Canyon spreading basins for indirect potable reuse (see Section 4.7). In addition, PWP is planning to construct the necessary facilities to capture urban runoff through connection of existing storm drains north of the planned Devil's Gate Reservoir to Eaton Canyon conveyance pipeline (Figure 4-2). This

would also provide water quality benefits to receiving waters where stormwater pollutants would otherwise be discharged.

On average, the project would send approximately 1,750 AFY of surface runoff to Eaton Canyon for recharge (including 500 AFY of flows from connections with the urban storm drain system). As described in the WIRP, PWP could potentially recover up to 35 percent of the total recharge as pumping credits or 627 AFY. The remaining recharge not allocated to other Raymond Basin pumpers who may opt to participate in the project will improve the health of the basin. Additional replenishment will also occur within Devil's Gate Reservoir and will provide an opportunity for enhanced habitat conditions for aquatic life by creating more sustained environmental flows in the Arroyo Seco downstream of the dam (this replenishment was not included in the estimated supply yield).

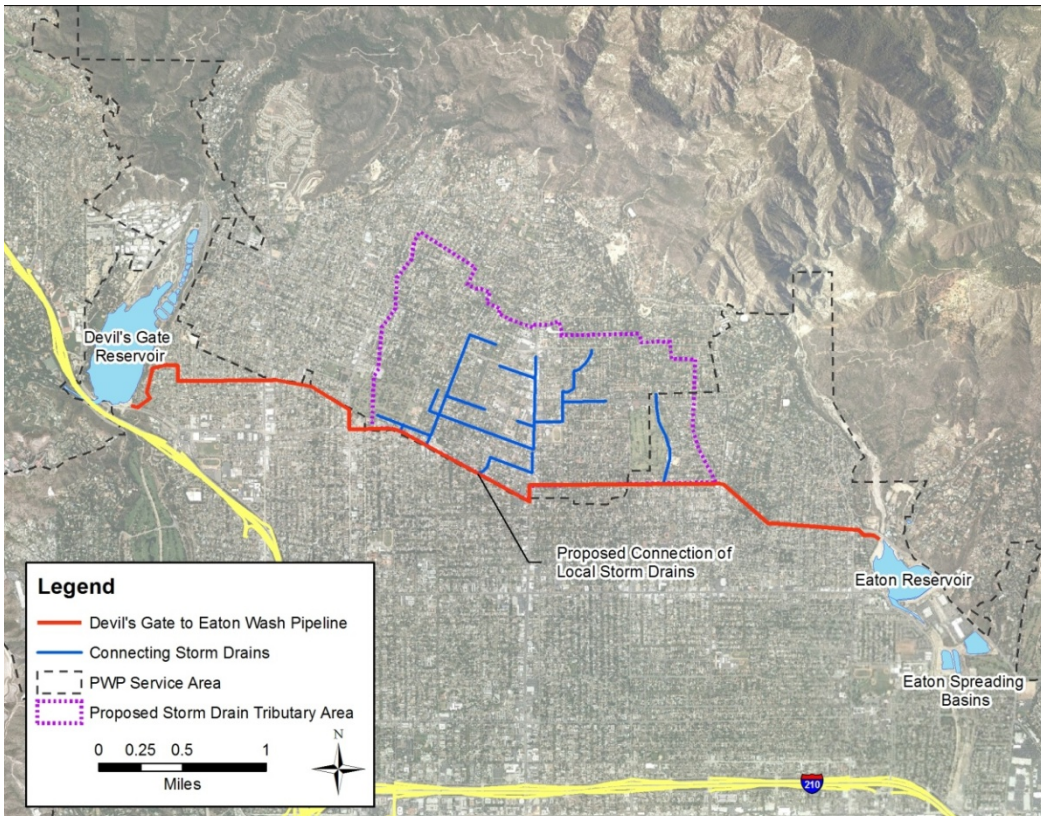

Figure 4-2. Devil's Gate Storage to Eaton Canyon Project

4.4.3 On-site Stormwater Projects

Stormwater projects within the City are led by the City of Pasadena Public Works Department (Pasadena Public Works), and are typically aimed at flood control and total maximum daily load (TMDL) water quality compliance. The main goal in evaluating stormwater projects with respect to the WIRP was to identify those projects which also provide water supply benefits. To the extent that cost-effective, multi benefit stormwater projects can be identified and demonstrated, it is recommended that Pasadena Public Works and PWP coordinate and partner (along with other regional stakeholders) to implement such projects. The WIRP estimated relatively small supply yields (~140 AFY) from implementation of on-site stormwater projects throughout PWP's service area. Estimates applied rough assumptions about the number of

projects that could be implemented over a 25-year planning period. Therefore, this supply source is not quantified for PWP's 2010 UWMP. However, the following types of on-site stormwater projects, which are included in the WIRP, will provide some additional supply over the 2010 through 2035 planning period:

- Residential rain barrels - Collect rainwater from rooftops and store in 100 gallon rain barrels for onsite irrigation use
- Residential rain gardens – Direct downspout from rooftop to garden bioretention area (approx. 30 ft^2)
- Residential infiltration strip/bioswale - Bio-retention strip at edge of lot to capture storm runoff and overwatering
- Commercial/Institutional parking lot swales - Large bio-retention area to collect runoff from parking lot areas
- Commercial/Institutional permeable pavement parking lots

Water Quality

Stormwater quality varies dependent upon the source of the runoff. As proposed in the WIRP, the storm-water projects involving the localized collection of water are to improve stormwater quality in local surface waters by capturing runoff and allowing percolation or in the case of rain barrels for non-potable onsite use.

4.5 Imported Water

MWD is the largest water wholesaler for domestic and municipal uses in California, providing on average 1.7 billion gallons of water per day through its vast infrastructure network to a service area of approximately 5,200square miles. Enabled by the California legislature in 1927, MWD's adopted purpose is to develop, store, and distribute water to southern California residents. Additionally, the Act allows MWD to sell additional water when it is available for other beneficial uses. In 1928 MWD was incorporated as a public agency following a vote by residents in 13 cities in southern California. Operating solely as a wholesaler MWD owns and operates the Colorado River Aqueduct (CRA), is a contractor for water from the California State Water Project (SWP), manages and owns in-basin surface storage facilities, stores imported water within local groundwater basins for conjunctive use storage, develops groundwater banking and water transfer programs to augment direct deliveries of SWP supplies, and provides incentives to local water agencies for water conservation, recycled water, groundwater recovery and

Figure 4-3. Major Water Conveyance Facilities in California

desalination. Today MWD has 26 member agencies consisting of 11 water districts, one county water authority, and 14 cities, including the City of Pasadena. Figure 4-3 shows the major surface water supply sources and conveyance for California that MWD relies on for direct deliveries and water transfers.

As a member agency of MWD, PWP has a contract to purchase imported water to supplement groundwater pumping. On average PWP receives 61 percent of its water from MWD based on the period of 1992 through 2008. PWP receives treated water via five turnouts from MWD's Upper Feeder. Water is treated at MWD's Weymouth Water Treatment Plant (WTP). During outages at the Weymouth WTP, PWP can receive treated water from MWD's Jensen WTP via three of the five turnouts. Sufficient turnout capacity exists to meet existing and projected PWP demands. Table 4-3 provides current and forecasted demands for imported water as provided to MWD for incorporation into its UWMP. Although PWP's connection capacity is adequate to meet future demands, reliability of MWD's imported water supplies have been reduced due to chronic droughts and environmental restrictions.

Table 4-3. Imported Water Projections

	2010	2015	2020	2025	2030	2035
Imported Water (AFY)	24,024	23,626	21,149	21,149	21,149	21,149

Imported Replenishment Water

PWP is proposing a conjunctive use program as part of its WIRP to store additional groundwater reserves when imported replenishment water is available from MWD. Imported replenishment water is purchased at a reduced rate in comparison to normal water purchases. The water would be cycled and extracted as needed to reduce imported water costs and provide increased supplies during dry years and emergency conditions. Water would be stored in the Raymond Basin using any combination of the following three methods:

- Direct injection – through existing and new wells that force water into the ground
- Existing spreading basins - allow water to percolate into the groundwater basin
- In-lieu recharge – PWP would reduce groundwater pumping and take more imported water in-lieu, thereby increasing storage in the basin.

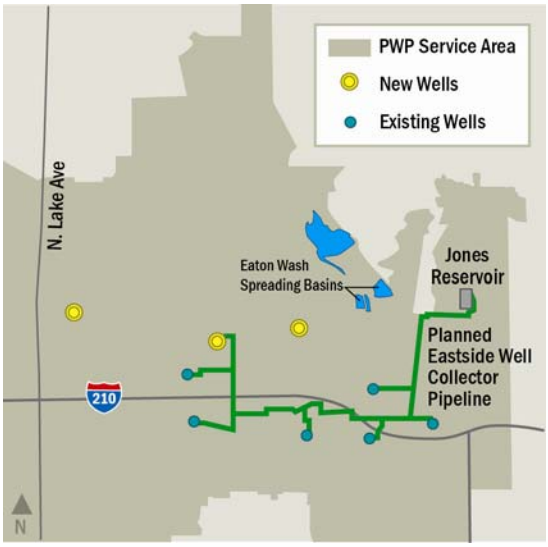

Figure 4-4. New Facilities Required for Pasadena's Groundwater Storage Program

Facilities required for the conjunctive use project include the planned Eastside Well Collector, which is a new pipeline and centralized chloramination facility at Jones Reservoir, as well as three new injection/ extraction wells. Other facilities for treated imported water spreading and injection are already in place, or are already in construction, including wells in the Monk Hill area. Figure 4-4 illustrates the new facilities required for the program.

Capital costs in 2010 dollars are estimated at $36.1 million based on planning level assumptions and are subject to change as additional studies will be completed prior to project implementation. Capital costs to increase well capacity as part of this program are beneficial for operational flexibility, water quality, and recovery of groundwater of other origins (such as indirect potable reuse, local surface spreading, and decreed rights), providing system-wide facility benefits regardless of whether imported water is recharged. Additional costs include operations and maintenance, including the purchase of MWD treated replenishment water. It is expected that this proposed project will be eligible for state and/or federal funding.

Replenishment would occur up to 20,000 AFY in a given year, but would average 6,500 AFY over time. Maximum groundwater extractions during drought or emergency situations would be up to 25,000 AFY. However, extractions would not occur for several years and would average 5,000 AFY over the planning horizon. Replenishment water does not place a demand on MWD, but rather is only available to agencies if MWD has excess water. The following assumptions were taken into consideration:

- Between 2011 and 2020, replenishment water will only be available 20 percent of the time.
- From 2021-2029, replenishment water would be available 50 percent of the time.
- From 2030-2035, replenishment water would be available 70 percent of the time.

In the 2010 to 2015 timeframe the following implementation actions are expected to occur:

- Complete projects underway to activate wells in the Monk Hill subarea and utilize Monk Hill storage account (via in-lieu).
- Construct Eastside Well Collector project. Near-term benefits include improved water quality of existing wells and increased operational flexibility.
- Negotiate use of storage account in Pasadena subarea with Raymond Basin Management Board. This may require additional groundwater study.
- Refine cost estimates and investigate capital improvements.

As part of an adaptive management approach the WIRP recommends reassessing the conjunctive use program every five years after 2015 to determine further implementation actions based on current conditions. In the future if replenishment water is less available than in today's assumptions then further study will be needed to analyze the costs and benefits without the financial incentive associated with replenishment water.

4.5.1 Water Quality

Water quality is a central consideration in MWD's long-term water resources planning activities as there are many water quality issues of concern to MWD for both CRA and SWP supplies. PWP receives imported water from MWD's Weymouth Water Treatment Plant. Historically water delivered from Weymouth was a blend of SWP and CRA water. Since 2008, deliveries have consisted primarily of CRA water as a result of reduced deliveries from the SWP. Water quality impacts have been considered by MWD in developing its

available water supply forecast in MWD's 2010 Integrated Resources Plan Update (IRP). Details of MWD's water quality initiatives are available in MWD's 2010 Regional Urban Water Management Plan (RUWMP).

State Water Project

Water quality issues for the SWP include total organic carbon (TOC), bromide, arsenic, nutrients, N-nitrosodimethlamine (NDMA), and pharmaceuticals and personal care products (PPCPs). TOC and bromide in SWP water present the greatest water quality issues and may restrict MWD's ability to use SWP water at various times as the contaminants form disinfection byproducts during water treatment processes. MWD has initiated a process to upgrade its treatment processes to ozone disinfection to reduce formation of disinfection byproducts and lift potential restrictions on SWP water usage. While salinity levels in SWP supplies are not high, MWD requires low salinity levels to meet blending requirements for CRA water, therefore an increase in salinity levels in SWP supplies is a concern to MWD. MWD expects existing source water protection programs to adequately address the other water quality issues.

MWD actively supports programs operated on behalf of DWR to improve SWP water. MWD supported DWR in establishment of a policy regarding water quality of non-SWP water transported through the SWP system. MWD has also supported expansion of DWR's Municipal Water Quality Investigations Programs to include additional water quality monitoring and advanced warnings to Contractors of water quality issues that may impact water treatment processes.

MWD is also utilizing its water supply portfolio options to conduct water quality exchanges. MWD has stored SWP water during periods of high water quality in groundwater storage basins for later use when SWP is at a lower water quality. These storage programs were initially designed to provide water during dry SWP conditions, but a few of these programs are now operated for dual-purposes.

Colorado River Aqueduct

Water quality issues associated with CRA supplies include high salinity levels (TDS), perchlorate, nutrients, uranium, chromium VI, N-nitrosodimethlamine, and PPCPs. High salinity levels, also known as total dissolved solids (TDS), present the most significant issue and the only foreseeable water quality constraint for the CRA supply. MWD expects its source control programs for the CRA to adequately address the other water quality issues. MWD has also bolstered its water security measures across all of its operations since 2001, including an increase in water quality tests.

The water quality of CRA water presents an issue for PWP's proposed groundwater replenishment program. CRA water does not meet Raymond Basin water quality objectives for sulfate or TDS. Therefore, it cannot be used for recharge via injection wells. Spreading operations are possible if the CRA water could be blended with surface water to improve water quality. PWP's WIRP recommends conducting a water quality study to evaluate the potential blending of imported water with local surface water from the proposed Devil's Gate Dam to Eaton Wash project. It is expected that in-lieu recharge and potentially spreading will be the only methods of recharge that meet Basin water quality objectives until at least 2020, if not longer.

4.5.2 Water Reliability

MWD's 2010 IRP Update serves as foundation for the supply forecasts discussed in the RUMWP and continues to ensure system reliability for its member agencies relying on imported water supplies. The 2010 IRP update concluded that the resource targets identified in previous updates, taking into

consideration changed conditions identified since that time, will continue to provide for 100 percent reliability through 2030. MWD's subsequent evaluation to extend the resource targets by an additional five years through their 2010 RUWMP also concluded the same full reliability during average (1922 – 2004 hydrology), single dry (1977 hydrology), and multiple dry years (1990 - 1992 hydrology). For each of the scenarios there is a surplus in every forecast year. Reliability of replenishment water is not taken into consideration as replenishment water is only available when MWD has excess supplies.

In addition to water quality, the main factors impacting the reliability of the SWP are:

- Delivery of contract allocations – The 2009 State Water Project Delivery Reliability Report indicates increased reductions in water deliveries on average when compared to previous reports as a result of environmental constraints and hydrologic changes derived from climate change.

- Bay-Delta issues – Multiple issues in the Bay-Delta region, at the confluence of the Sacramento and San Joaquin Rivers, where major SWP pumping facilities are located include pumping restrictions associated with protection of fish species protected under the Endangered Species Act and deteriorating infrastructure associated with levees.

Supply apportionment is the main factor, in addition to water quality, impacting the reliability of the CRA. MWD previously received unused supplies in excess of its apportionment, however, as other users have began to use their full apportionments excess water is no longer available. California's Colorado River Water Use Plan prepared by the California Department of Water Resources (DWR) identified actions that California will take to operate within its 4.4 million acre-feet entitlement. Completion of the Quantification Settlement Agreement (QSA), which established baseline water use for each California Party with rights to the Colorado River, is a critical component of the California Plan. On February 11, 2010 the QSA and 11 other agreements were ruled as invalid. MWD and others are currently appealing the decision. If the decision stands, programs authorized as part of the QSA will be delayed, costs may increase, or other adverse impacts may occur. Ultimately, the impact of the court's decision cannot be determined pending the outcome of the appeal.

MWD Integrated Resources Plan

To address these imported water supply issues, MWD initiated the first regional Integrated Resources Plan (IRP) in 1993 (adopted in 1996). MWD's IRP was updated in 2004, and again in 2010. The IRP represents a regional strategy to improve water reliability for its 26 member agencies, while factoring in cost, water quality, regulatory issues and other considerations.

Upon initiating the 2010 IRP Update, MWD was faced with new challenges with unknown consequences, such as climate change, environmental constraints in the Bay-Delta, and prolonged droughts. To address changing conditions and trends with the potential to disrupt water supplies, MWD conducted a strategic policy review as a component of the 2010 IRP Update. Results of this process led MWD to utilize a three-part adaptive resource management strategy as part of the latest IRP Update.

In response to the inherent uncertainty of water resources, an adaptive management strategy allows MWD to effectively respond to unplanned water supply disruptions utilizing cost effective strategies. These new challenges require adaptive management to ensure infrastructure and supplies are available when needed. The strategy serves as the centerpiece for assisting MWD in meeting uncertainties.

The 2010 MWD IRP has three main components: (1) to meet water demands by building on its existing core resources to provide reliability under foreseen conditions; (2) to implement a supply buffer of 10 percent of retail demand through multiple actions to adapt to short-term uncertainty; and (3)to implement adaptive management through low-regret foundation actions, monitoring of key vulnerabilities and bringing adaptive resource options online, if required, and using a comprehensive approach to meet specific needs and degrees of shortages. Each component contains multiple milestones to guide attainment of water resource targets.

MWD IRP Core Resources Strategy

The core resources strategy is to increase its existing resources and storage levels to maintain reliability throughout the planning horizon. Table 4-4 summarizes the targets for increasing core resources. As shown in this summary, significant increases in both imported water supplies (through a Delta "fix" for the SWP, and water transfers and banking in the Central Valley and Colorado River) and local supplies of MWD's 26 member agencies are identified. In addition, MWD is relying on compliance of the new statewide 20 percent conservation target by 2020 of all retail water providers in the region. The additional local water supply and water conservation that MWD is counting on from its member agencies and local water providers is 426,000 acre-feet per year by 2035.

Table 4-4. MWD Core Resources Strategy Targets

Forecast year	Targets (Thousands of AF per Year)				
	2015	2020	2025	2030	2035
State Water Project Improvements in Bay-Delta	151	151	283	283	283
Colorado River Aqueduct Dry Year Supply	411	303	351	386	370
Local Resources Augmentation	16	16	46	46	46
20 percent by 2020 Retail Compliance[(1)]	190	380	380	380	380
Total Core Resources Development	768	850	1,060	1,095	1,079

[(1)] Demand reductions are achieved by a combination of conservation and increased use of recycled water.
Source: Final 2010 Integrated Water Resources Plan Update, Metropolitan Water District of Southern California

Since 1982, MWD has assisted local agencies with financial incentives, through the Local Resource Program (LRP), to develop local core resources with the goal of increasing regional reliability cost effectively. Existing local core resources include recycled water, groundwater recovery, and seawater desalination. Through the LRP, MWD traditionally provides incentives for actual production of supplies.

The Water Conservation Act of 2009 requires water agencies to reduce per capita water use by 20 percent by 2020. Reductions include increasing recycled water use to offset potable water use. As part of its core resources strategy MWD is accounting in its IRP Update for increased conservation associated with meeting the 20 percent by 2020 requirements. On an individual agency basis, MWD has estimated reduced potable demands in 2020 of approximately 380,000 AFY. Obtaining regional consistency with the requirements would further reduce potable demands by an additional 200,000 AFY for a total of 580,000 AFY; however this additional reduction is targeted towards MWD's buffer supplies as described below. In 2035, 20 percent by 2020 retail compliance savings through existing programs are expected to be 380,000 AFY.

MWD IRP Supply Buffer

Building upon past IRP Updates, MWD identified uncertainties and developed contingency plans while expanding its planning buffer program first developed in the 2004 IRP Update. The 2010 IRP Update seeks to create a buffer against demand uncertainty through development of a supply buffer equal to 10 percent of total retail demand, while the adaptive management concept seeks to mitigate against supply uncertainty to further increase reliability (see Table 4-5).

Table 4-5. MWD's Buffer Supplies (AFY)

Supply	2015	2020	2025	2030	2035
Local Resources Augmentation	100,000	200,000	200,000	200,000	200,000
20 percent by 2020 Regional Level Compliance[(1)]	130,000	280,000	280,000	290,000	300,000
Total Buffer	230,000	480,000	480,000	490,000	500,000

[(1)] 20 percent by 2020 compliance is achieved by conservation and increased use of recycled water.
Source: 2010 Integrated Water Resources Plan Update, Metropolitan Water District of Southern California

MWD IRP Reliability Analysis

To demonstrate the reliability of the IRP Update and resource targets through 2035, MWD analyzed regional demands, supplies, and storage and transfer availability under dry weather conditions. Through a three prong approach consisting of core supplies, buffer supplies, and adaptive management MWD will exceed 100 percent reliability through 2035, inclusive of a 10 percent supply buffer. Figure 4-5 shows regional water demands without conservation from 2015 to 2035 under dry weather. The graph also depicts the forecast supply sources, inclusive of storage and transfers.

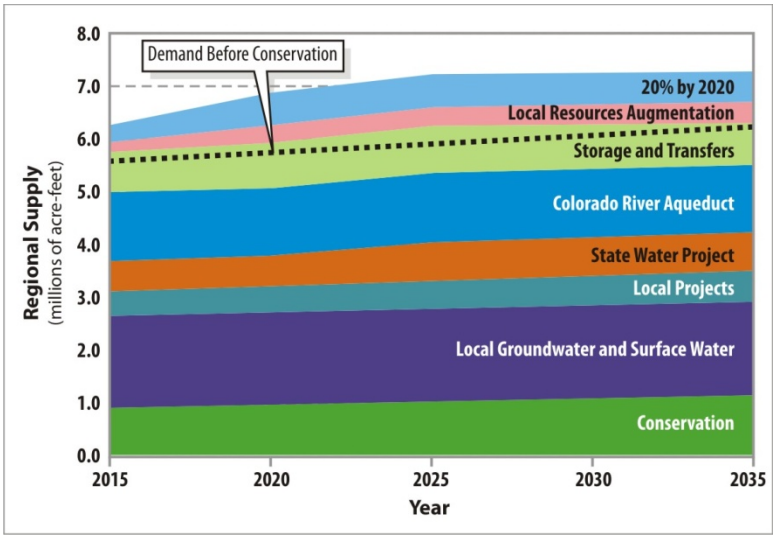

Figure 4-5. MWD Regional Water Demand and Supplies Dry Weather Scenario

Through the IRP Update, MWD has shown that it will be able to meet the supplemental needs of all its member agencies reliably through 2035, even during prolonged drought events. Buffer supplies provide an extra precaution to maintain reliability. MWD has implemented an adaptive management program allowing MWD to maintain reliability by rapidly responding to uncertain conditions that may impact core resources. MWD has demonstrated that it has a plan for implementing and financing the IRP targets.

However, it is important to note that achieving the levels of reliability included in MWD's IRP Update assumes the following:

- A comprehensive solution to the decades-old conflicts in the Sacramento-San Joaquin Delta is implemented within the next 10-15 years.

- The court ruling on the Colorado QSA will not adversely impact MWD's ability to keep the CRA at nearly full most of the time.

- Significant increases in water conservation and local resources development by MWD's member agencies and local water providers, such as PWP.

4.6 Recyled Water

Through its WIRP process, PWP has identified recycled water as a future component of its water supply portfolio. Recycled water is one of six elements identified in the WIRP as essential to increasing supply reliability and offsetting potable water demands to meet 20x2020 water conservation requirements. To develop this supply and maximize its use, PWP is in the process of developing a Recycled Water Master Plan (RWMP) that builds upon previous recycled water planning efforts and identifies end users. Historically, PWP has not used recycled water.

In 1991, PWP conducted an economic feasibility study to determine the most cost effective source of recycled water for the service area. Results of the study indicated it was more economically feasible to obtain recycled water from the Los Angeles/Glendale Water Reclamation Plant (LAGWRP) than from the closest Los Angeles County Sanitation District's water recycling plants (WRPs) where Pasadena's wastewater is treated, the Whittier Narrows and San Jose Creek WRPs. In 1993, the City signed an agreement, Reclaimed Water System Participation Agreement No. 15,075, with the City of Glendale entitling PWP to 6,000 AFY of recycled water at the rate of 6,255 gallons per minute from the LAGWRP. The agreement has a termination date of December 31, 2017, but Pasadena has a right to extend the contract. When build-out of Glendale and PWP's recycled water systems occurs an important clause in the contract may reduce PWP's deliveries during periods of peak demands if the amount of recycled water is insufficient to meet Glendale's and PWP's needs. If this occurs, both Cities must split the recycled water on an equal basis temporarily reducing PWP's share to 4.5 mgd until peak demands drop.

4.6.1 Wastewater Collection and Treatment Systems

City of Pasadena and Los Angeles County Sanitation District

Water recycling is dependent upon the logistical aspects of an area's wastewater and collection systems. Wastewater generated within the PWP service area is treated outside the service area by the Los Angeles County Sanitation District (LACSD) at two WRPs. LACSD provides wastewater treatment for 78 cities throughout Los Angeles County. As a result of the distance and elevation differences between the service area and the WRPs it is not feasible for PWP to obtain recycled water from wastewater generated within the PWP service.

Within the City of Pasadena, there are approximately 3,500 miles of sewer lines ranging from 6 to 42 inches in diameter and 2 sewer pump stations. Ultimately, all wastewater generated within the City is conveyed to regional interceptors within the City or in the adjacent City of San Marino. These regional interceptors are owned and operated by the LACSD. Dry weather flows for the City are estimated at 13.8 mgd. Flows conveyed to LACSD's system are not metered. No wastewater treatment occurs within the City of Pasadena or PWP's service area. Wastewater generated within the PWP service area is treated by LACSD at both the Whittier Narrows Water Recycling Plant (WRP) and San Jose Creek WRP.

The Whittier Narrows WRP is located approximately 12 miles southeast of Pasadena near the City of South El Monte. This plant is the first water reclamation plant constructed by LACSD in 1962. Approximately 15 mgd of wastewater is treated for a population of 150,000. Wastewater is treated to a tertiary level in compliance with California Department of Public Health Title 22 standards. Almost all of the recycled water produced is used for recharge of the Rio Hondo and San Gabriel Coastal Spreading Grounds or for irrigation purposes at a nearby nursery. Solids are conveyed to LACSD's Joint Water Pollution Control Plant.

The San Jose Creek WRP is located approximately 22 miles southeast of Pasadena near the City of Industry. The WRP has a treatment capacity of 100 mgd and treats approximately 70 mgd of wastewater for a service area with approximately 1 million people. The WRP produces approximately 39 mgd of recycled water for use at 93 sites, including groundwater recharge and irrigation of greenbelts, school facilities, and parks. The remainder of the recycled water is discharged to the San Gabriel River. Similar to the Whittier Narrows WRP, solids are conveyed to the LACSD Joint Water Pollution Control Plant for treatment.

Los Angeles/ Glendale Water Reclamation Plant

A joint project of the City of Los Angeles and City of Glendale, the LAGWRP began treating wastewater in 1976. The plant is located in the City of Los Angeles, approximately 6 miles west of the City of Pasadena. Originally the plant was designed without considering nutrient removal. Its average dry-weather flow design capacity is 20 mgd and currently treats about 17.7 mgd. Wastewater is treated from the east San Fernando Valley region of the City of Los Angeles delivered via Los Angeles' North Outfall Sewer, the cities of Glendale and Burbank, and unincorporated areas of Los Angeles County served by the City of Glendale's sewer collection system.

Glendale and Los Angeles are entitled to 50% of the plant capacity, including recycled water production. Pasadena purchased rights to 60% of Glendale's capacity (6,000 AFY), but has not exercised the rights. The current level of treatment is tertiary to Title 22 standards with nitrogen removal (NdN). Tertiary recycled water with disinfection produced at LAGWRP can be used for all irrigation uses, industrial uses, impoundment uses, and other uses as specified in Title 22. Recycled water from the LAGWRP is currently used by both Los Angeles and Glendale. Los Angeles uses recycled water from LAGWRP for landscape irrigation for Griffith Park, Taylor Yard, and the Los Angeles Greenbelt Project, including Forest Lawn Memorial Park, Mount Sinai Memorial Park, Universal Studios, and Lakeside Golf Course. The City of Glendale retains the right to half of the recycled water produced at the plant and serves multiple customers with recycled water. Recycled water in excess of demands is discharged into the Los Angeles River. All recycled water provided by LAGWRP meets, at a minimum, Title 22 standards Table 4-6 summarizes the LAGWRP.

Table 4-6. Wastewater Treatment Plant Summary

Wastewater Treatment Plant	Treatment Level	Capacity (mgd)	Average Flows (mgd)[1]
Los Angeles - Glendale Water Reclamation Plant	Tertiary to Title 22 standards with Nitrification/Denitrification	20	17

[1] Average dry weather flows for 2008.

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Wastewater Treatment, November 2, 2009

Average dry-weather wastewater influent projections for LAGWRP are expected to increase by approximately 45% over the next 25 years. Wastewater effluent that is not recycled is disposed via the Los Angeles River to the Pacific Ocean. Average dry-weather flow projections for LAGWRP to 2035 and the disposal method is provided in Table 4-7.

Table 4-7. Wastewater Treatment Plant Average Dry-Weather Flows and Disposal Methods

Wastewater Treatment Plant	Disposal Method	Average Dry-Weather Flow Projections (AFY)					
		2010	2015	2020	2025	2030	2035
Los Angeles /Glendale Water Reclamation Plant	Recycling and Ocean via Los Angeles River	23,229	25,427	27,331	29,460	31,588	33,716

Source: City of Los Angeles Recycled Water Master Plan Technical Memorandum, Draft Wastewater Flow Projection, September 30, 2009

4.6.2 Past and Current Recycled Water Planning Efforts

Since 1991 multiple recycled water planning efforts have been initiated culminating in the recently completed WIRP and the RWMP currently in progress. Table 4-8 lists recycled water-related planning documents previously prepared leading to current planning efforts.

Table 4-8. Past Recycled Water-Related Planning Studies

Study Name	Year Completed
Preliminary Reclaimed Water Users Study	1992
City of Pasadena Reclaimed Water Incremental Analysis Report for Joint Project with the City of Glendale	1992
Pasadena - Glendale Reclaimed Water Reservoir	1994
Report on Groundwater Quality Impact Assessment	1995
Water Reclamation Program Review Memorandum	2000
Phase 1 Reclaimed Water Feasibility Study	2003
Recycled Water Feasibility Study	2005

Potential Recycled Water Demand

As part of the RWMP under development a market analysis was conducted to determine potential end users of recycled water. Potential recycled water demands are estimated at 3,840 AFY split between 86 customers. The majority of potential demands are attributed to irrigation, and commercial and industrial cooling equipment. Additionally, the WIRP carries forward the option of groundwater recharge and recovery for potable use from the RWMP. No potential uses were identified for agriculture, wildlife enhancement, or wetlands. Demands for this project have not been fully developed at this time as the project is dependent upon multiple factors that will be further evaluated after 2015. Table 4-9 summarizes potential recycled water demands by customer type.

Table 4-9. Potential Recycled Water Demand

Potential Uses of Recycled Water	Number of Customers	Estimated Demand (AFY)
Irrigation	70	2,675
Commercial/Industrial	9	215
Mixed Use[(1)]	7	950
Total	86	3,840

[(1)] Mixed use customers have multiple uses - both irrigation and commercial or industrial uses

Source: Pasadena Water and Power Recycled Water Planning Study Draft prepared by RMC, December 30, 2010

Preferred Alternative

Alternatives were developed for the distribution system and finite supplies during the RWMP process with the purpose of identifying an alternative to maximize local water supplies to offset supplemental water purchases from MWD in a cost-effective manner. This process included a technical and economic review of the feasibility of serving the identified potential recycled water users. Select representative alternatives from the RWMP were evaluated in the WIRP for further consideration in conjunction with other water supply options. As recommended in the WIRP, Hybrid 1 encompasses the following recycled water components developed in the RWMP and as depicted in Figure 4-6:

- *Phase 1 non-potable reuse:* A recycled water distribution system to provide tertiary treated water to customers for landscape irrigation demands. The Phase 1 system is primarily routed to Brookside Golf Course, Brookside Park, and nearby customers. The Phase 1 recycled water system would serve approximately 1,130 AFY of non-potable demands, and construction could occur in two phases: (1) Core Phase 1 system that extends to Brookside Golf Course and connects adjacent customers along the way; and (2) Expanded Phase 1 system that provides service to additional customers in the northwest and central eastern part of the service area (including Brookside Park).

- *Tertiary treated indirect potable reuse*: This concept involves conveyance of tertiary-treated recycled water to Eaton Canyon for groundwater replenishment and recovery for potable use. The option proposes to blend recycled water with natural surface runoff from Eaton Wash along with Arroyo Seco diversions from the proposed Los Angeles County Department of Public Works Devil's Gate Dam to Eaton Canyon project. Per the RWMP evaluations, replenishment located at Eaton Canyon spreading basins is recommended due to challenges in meeting retention time requirements and potential mounding issues at the Arroyo Seco spreading areas. The water would be conveyed through the Core Phase 1 recycled system, and a relatively short segment of additional pipe would be needed to reach the conveyance system for the Devil's Gate Dam to Eaton Canyon project.

In addition, a project is being considered to capture water from existing groundwater tunnels that currently discharge water to the Arroyo Seco for non-potable supply to Brookside Golf Course. The tunnel water would be routed to a storage pond and serve a portion of the irrigation demands at the golf course. The tunnel project would yield approximately 400 AFY of supply under current hydrogeologic conditions. Yield from the tunnels would help satisfy the same demands as the Phase 1 recycled water system, but would offset recycled water purchases from the LAGWRP. It is recommended that this project be designed

with the potential to connect the tunnel water to the Phase 1 recycled water system, and deliver blended water to customers.

It should be recognized that the reliability of the tunnel water is uncertain at this time since additional pumping is expected on the west side of the groundwater basin once the Monk Hill treatment plant is online. This pumping could decrease local groundwater levels and reduce tunnel flows. However, implementation of the Devil's Gate Dam storage option discussed in the WIRP is expected to replenish groundwater levels in the area and may improve tunnel yields.

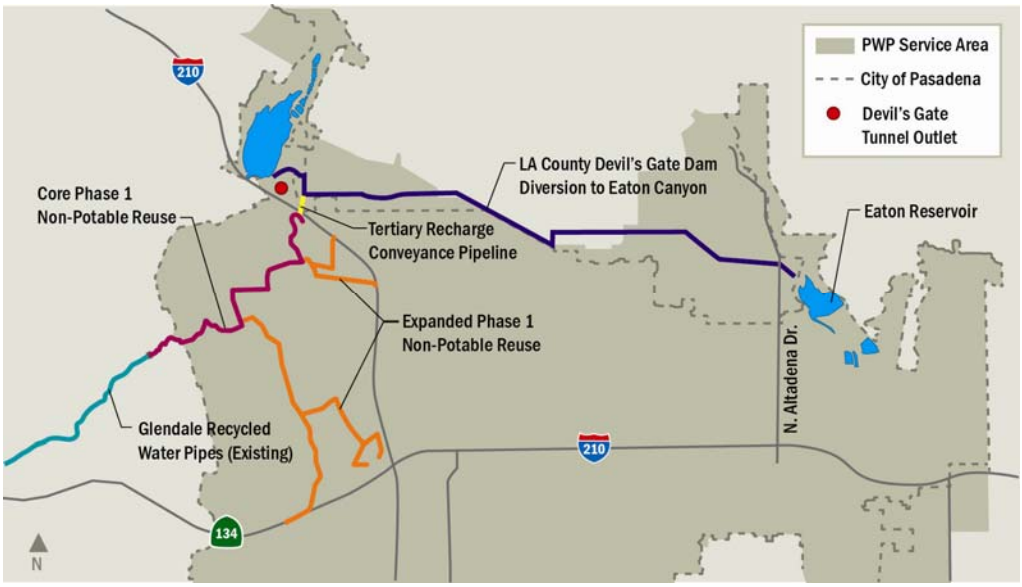

Figure 4-6. Recycled Water Preferred Alternative

Implementation Challenges

The main implementation challenges associated with recycled water are:

- Non-potable reuse requires customer participation to be successful.
- Regulatory challenges for indirect potable reuse of tertiary-treated water.
- Extensive public education and outreach anticipated for implementation of indirect potable reuse.

Potential barriers end users may experience include the cost of conversion, water quality, and public acceptance. Additional equipment is required beyond a recycled water meter. End users using recycled water for irrigation are typically concerned about TDS levels, but commercial or industrial users may also be concerned about water quality as their processes may require certain levels of water quality. Public acceptance of recycled water for irrigation and in cooling towers is critical as the public may potentially be exposed to recycled water at parks, schools, and golf courses or indirectly exposed to recycled water through its use in cooling towers. PWP is incorporating these issues into its work plans for implementing a recycled water system.

Adaptive Implementation Strategy

An adaptive implementation strategy was developed as part of the WIRP for recycled water implementation outlining the various steps needed within given timeframes. The following steps are recommended in the 2010 -2015 timeframe:

- Develop ordinances that require new developments along planned recycled water corridors to have recycled water connection capability.
- Develop cost estimates, financial analysis of PWP funding toward projects, and potential funding sources through partnerships and grants.
- Financial analysis to determine non-potable water rates to customers.
- Develop partnership with Brookside Golf Course and monitor progress of the tunnel project, with a goal of completion by 2013 and capability to connect tunnel water to future recycled water system.
- Acquire necessary permits, design and construct Core Phase 1 recycled water system (by 2015).
- Monitor progress of the Devil's Gate storage to Eaton Canyon project and coordinate with LACDPW regarding use conveyance infrastructure for indirect potable reuse project.
- Coordinate with Raymond Basin Management Board for indirect potable reuse project regarding spreading credits and potential cost-sharing.
- Initiate California Department of Public Health (CDPH) and Regional Water Quality Control Board (RWQCB) regulatory permitting for tertiary-treated indirect potable reuse. This may require additional groundwater modeling.

In the 2015-2020 timeframe it is recommended that if Devil's Gate storage to Eaton Canyon project is underway and PWP has received CDPH and RWQCB regulatory approval for tertiary treated indirect potable reuse, PWP should move forward with tertiary indirect potable reuses, with a goal of construction by 2017. In addition, PWP should evaluate the next step in expanding recycled water use.

Per RWMP evaluations, the primary limiting factor for the amount of recycled water that can be used for tertiary treated indirect potable reuse is the availability of diluent water for blending, which is currently assumed to require a mixture of 80 percent diluent water (such as surface water from Eaton Wash or Devil's Gate storage to Eaton Canyon) with 20 percent recycled contribution water for groundwater recharge. If regulatory requirements in the future allow for more recycled water contribution, it is recommended that additional recycled water be utilized for groundwater replenishment instead of expanding the Phase 1 non-potable system, since indirect potable reuse would be more cost effective. This next step in expanding recycled water use could be implemented within a few years after tertiary indirect potable reuse is constructed.

If tertiary indirect potable reuse does not receive regulatory approval or public support, PWP could implement phased additional non-potable reuse.

Additionally, implementation of recycled water will require public outreach to promote recycled water for end users, including incentives. Recycled water use and indirect potable reuse will require gaining public acceptance to overcome concerns. Going forward PWP will develop public outreach plans for recycled water use and indirect potable reuse and determine if financial incentives for end users are necessary. It is anticipated that these plan coupled with the adaptive implementation strategy will allow PWP to maximize the use of its available recycled water supply from LAGWRP.

Cost

Estimated costs for implementing the recycled water component of Hybrid 1 in 2010 dollars range from $17.55 million to $68.65 million, not including any required end user retrofits. These costs are based on planning level assumptions and are subject to change as additional studies are completed. The broad cost range is attributed to the indirect potable reuse component. At this time it is unknown whether advanced treatment of the source water (LAGWRP) will be required prior to spreading. It is estimated that these costs could be potentially offset by state and federal funding. Table 4-10 summarizes the major recycled water capital component costs. In addition, there would be operations and maintenance costs associated with purchasing the recycled water from Glendale, pipeline maintenance, groundwater pumping, and advanced treatment, if deemed necessary.

Table 4-10. Estimated Preferred Alternative Recycled Water Capital Costs

Component	Cost (millions) (2010 $)
Tunnel Water to Brookside Golf Course	$0.95
Core Phase 1 Non-Potable Distribution System with Tunnel Augmentation[(1)]	$6.80
Expanded Phase 1 System	$5.80
Indirect Potable Reuse[(2)]	$4.0 - $55.1
Total	$17.55 - $68.65

[(1)] Does not include any required end user retrofit costs.
[(2)] The higher end of the range will only be required if advanced treatment is required.
Source: Pasadena Water and Power Water Integrated Resources Plan prepared by CDM, January 12, 2011.

4.6.3 Projected Recycled Water Use

Table 4-11 provides a summary of projected recycled water use in five year increments beginning in 2010 and ending in 2035 for both non-potable water use and groundwater recharge. Non-potable water use includes 400 AFY of tunnel water. Based on the projected level of recycled water use and PWP's contract for recycled water from LAGWRP it is forecast that this supply source will be reliable throughout the projection period. PWP's 2005 UWMP did not project recycled water use commencing until 2020.

Table 4-11. Recycled Water Use Projections

	2010	2015	2020	2025	2030	2035
Non-Potable Use (AFY)	0	1,130	1,130	1,130	1,130	1,130
Groundwater Recharge (AFY)	0	0	920	920	920	920
Total (AFY)	0	1,130	2,050	2,050	2,050	2,050

Water Quality

Recycled water produced at LAGWRP has not been subject to water quality or reliability issues in the past. All water produced meets, at a minimum, Title 22 standards. After completion of the non-potable distribution system, PWP will remain in contact with end-users to ensure the recycled water quality meets the end users requirements. Groundwater recharge with tertiary treated recycled water will require extensive permitting and monitoring requirements to ensure the groundwater is not degraded. Further treatment of the water may be required using advanced treatment. If groundwater recharge is not feasible, PWP can implement an additional phase of non-potable reuse to maximize recycled water use and maintain the forecasted reliability.

4.6.4 Recycled Water Coordination

Preparation of the RWMP and the recycled water component of the WIRP required close coordination with multiple agencies. Preparation of the WIRP was a stakeholder driven process. A WIRP Advisory Committee was formed representing a wide range of interests and backgrounds. Additionally, a series of public workshops was held to involve the public. Table 4-12 lists agencies that coordinated with PWP during preparation of these planning documents.

Table 4-12. Agencies Participating in WIRP and/or RWMP Process

Agency Name
State Water Resources Control Board
United States Bureau of Reclamation
Glendale Water and Power
Foothill Municipal Water District

4.7 Transfer or Exchange Opportunities

The general types of transfers or exchanges available to PWP, are summarized below:

- ***Core Transfers*** make water available through multi-year contracts that convey a specific amount of water to the purchaser each year. The specific conditions depend on the agencies involved and contract terms. An example would be a transfer of SWP long-term water supply (Table A) contract water from an agricultural contractor to urban uses.

- ***Spot Transfers*** make water available for a limited duration (typically one-year or less) through a contract executed during the year of delivery. Some examples of spot transfers are the State Drought

Water Bank in the critically dry year of 1991 and the State's voluntary water purchase program in 2001.

- ***Option Transfers*** are multi-year contracts that allow the purchaser to obtain a specified quantity of water at some future date. They usually require a minimum payment for water even if the water is not needed in a given year. An option or "take" price is established in years water is drawn.

- ***Storage Agreements*** allow one entity to lease or purchase storage in another entity's surface or groundwater storage facility.

- ***Water Exchanges*** are agreements that allow two agencies to exchange water from one source for water from another source, typically during the same year. Exchanges can also occur with the same source where one agency exchanges its right to take water at a given time from the source with another agency, and then can take the water from the source at another time. Exchanges can also involve storage agreements.

Historically PWP has occasionally sold water through existing interconnections with other agencies when PWP had additional supplies available. PWP has interconnections with ten agencies. Some of the interconnections are for emergency use only, while others allow the delivery or receipt of water. PWP recently had short-term standing agreements with Lincoln Avenue Water Company and Cal-American Water Company for delivery of an insignificant amount of water. These past agreements have not had a significant impact on PWP's supplies.

PWP has also engaged in leasing groundwater storage space in the Raymond Basin from other agencies with rights in the basin both as a lessor and lessee to maximize this supply source given current extraction capabilities. Agencies PWP has engaged in leases with include Lincoln Avenue Water Company, Valley Water Company, East Pasadena Water Company, City of Sierra Madre, La Canada Irrigation District, Rubio Canon Land and Water, and Kinneloa Irrigation District.

4.8 Desalinated Water

PWP is not planning to use desalinated water as part of its water supply portfolio. PWP is located too far inland to desalinate ocean water and there is no readily available supply of brackish groundwater or surface water. However, there is a potential opportunity to develop a partnership with a regional agency to construct a desalination facility. There is a potential opportunity to partner with the San Diego County Water Authority (SDCWA) on development of a new desalination project in San Diego County near Camp Pendleton. To participate, PWP would pay a purchase cost for water once the plant is constructed. This would be an exchange agreement since PWP could not physically receive the water. SDCWA member agencies would receive the desalinated water and in return, PWP would receive the water allocation via MWD's facilities.

4.9 Summary of Supplies

Table 4-13 summarizes current and planned water supplies extending to 2035 in five-year increments for an average hydrology.

Table 4-13. Current and Planned Water Supplies Average Hydrology

	2010	2015	2020	2025	2030	2035
Current Supplies (AFY)						
Existing Groundwater	12,056	10,304	10,304	10,304	10,304	10,304
Existing Surface Supplies	2,380	2,380	2,380	2,380	2,380	2,380
MWD Imported Water Purchases[(1)]	24,024	23,626	21,149	21,149	21,149	21,149
Subtotal Planned Supplies	38,460	36,310	33,833	32,253	32,253	32,253
Planned Supplies (AFY)						
Recycled Water						
Non-Potable	0	1,130	1,130	1,130	1,130	1,130
Groundwater Recharge	0	0	920	920	920	920
Devil's Gate Surface Diversion	0	0	627	627	627	627
Groundwater Storage Program[(2)]	0	0	0	0	0	0
Subtotal Planned Supplies	0	1,130	2,677	2,677	2,677	2,677
Total Supplies (AFY)	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**

[(1)] Data from Table 4-3.

[(2)] During average years this program will not produce water supplies, but in dry years or emergencies will produce up to 5,000 AFY.

Table 4-14 lists major projects planned during the 2010 to 2035 timeframe and discussed previously within this section. All planned projects will increase PWP's reliability and reduce its reliance on imported water. Projects that will increase available supplies are the Devil's Gate Surface Diversion, Phase 1 Non-Potable Reuse, and Tertiary Treated Indirect Potable Reuse. On-site stormwater projects will provide a negligible increase in supplies, but will also assist with reducing pollutant loading of stormwater. Groundwater replenishment with imported replenishment water will increase PWP's reliability by providing a local supply during droughts and emergencies. The Sunset Treatment Plant and Eastside Well Collector projects will not provide new yields, but will allow maximization of existing yields.

Table 4-14. Planned Projects

Projects	Yield (AFY)
Devil's Gate Surface Diversion	627
On-site Stormwater Projects	140
Phase 1 Non-Potable Reuse	1,130
Tertiary Treated Indirect Potable Reuse	920
Groundwater Storage of Imported Water	Up to 5,000*
Sunset Treatment Plant	No new yield
Eastside Well Collector	No new yield

* To be produced in dry years and emergencies

In addition to the planned projects in Table 4-14, PWP's WIRP has identified a number of potential stormwater capture projects that could recharge the groundwater basin by over 1,000 AFY and potentially provide PWP with over 130 AFY of direct water supply benefit. These projects include bioswales, cisterns, rain gardens, and permeable pavement. However, the development of a stormwater master plan was recommended as part of the WIRP to analyze the cost/benefit of multipurpose stormwater management projects and more thoroughly estimate potential water supply yields.

This page intentionally left blank.

Section 5
Water Supply Reliability and Shortage Contingency Plan

5.1 Law

California Water Code Section:

10620 (f) An urban water supplier shall describe in the plan water management tools and options used by that entity that will maximize resources and minimize the need to import water from other regions.

10631 (c) (1) Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage, to the extent practicable, and provide data for each of the following:

- An average water year
- A single dry water year
- Multiple dry water years

10631 (c) (2) For any water source that may not be available at a consistent level of use, given specific legal, environmental, water quality, or climatic factors, describes plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable.

10631 (h) Include a description of all water supply projects and water supply programs that may be undertaken by the urban water supplier to meet the total projected water use as established pursuant to subdivision (a) of:

10632. The plan shall provide an urban water shortage contingency analysis, which includes each of the following elements, which are within the authority of the urban water supplier:

10632 (a) Stages of action to be undertaken by the urban water supplier in response to water supply shortages, including up to a 50 percent reduction in water supply, and an outline of specific water supply conditions which are applicable to each stage.

10632 (b) An estimate of the minimum water supply available during each of the next three years based on the driest three-year historic sequence for the agency's water supply.

10632 (c) Actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.

10632 (d) Additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street-cleaning.

10632 (e) Consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are appropriate for its area, and have the ability to achieve a water use reduction consistent with up to a 50 percent reduction in water supply.

10632 (f) Penalties or charges for excessive use, where applicable.

10632 (g) An analysis of the impacts of each of the actions and conditions described in subdivisions (a) to (f), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of reserves and rate adjustments.

10632 (h) A draft water shortage contingency resolution or ordinance.

10632 (i) A mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis.

10635 (a) Every urban water supplier shall include, as part of its urban water management plan, an assessment of the reliability of its water service to its customers during normal, dry, and multiple dry water years. This water supply and demand assessment shall compare total water supply sources available to the water supplier with the total projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and multiple dry water years. The water service reliability assessment shall be based upon the information compiled pursuant to Section 10631, including available data from state, regional, or local agency population projections within the service area of the urban water supplier.

5.2 Introduction

This section of the UWMP describes factors that affect water supply reliability, estimates water supplies water for the next three years based on the driest three-year historic hydrology, and compares existing water and planned water supplies with projected water demand between 2010 and 2035. This evaluation of water reliability requires the integration of information provided in previous sections of this UWMP including Section 3, which presents PWP's projection of water demand before conservation and quantifies additional demand reduction needed to meet new requirements from the recently adopted Water Conservation Bill. Also critical to assess reliability is information from Section 4 describing and quantifying the various sources of water supply available to meet water demands and any impacts associated with water quality.

5.3 Water Reliability

PWP was proactive in developing the WIRP as a means to increase the long-term reliability of its water supplies. Water reliability was one of eight objectives established during the WIRP process to aid in the selection of a preferred alternative. MWD, PWPs imported water supplier, has also undertaken extensive efforts, including developing additional supply sources, to maintain system reliability as discussed in Section 4. Several factors affect water supply reliability in PWP's service area, including:

- Existing or potential water quality issues;
- Potential impacts of long-term climate change
- Environmental issues
- Facility constraints.

The impact of these factors on supply yield depends upon many factors unique to each type of supply, as summarized in Table 5-1 and described further below. PWP does not have known legal issues that will affect water supply reliability. Section 5 summarizes the reliability of each source of supply and the influence of reduced yields on PWP's ability to meet current and projected water demand.

Table 5-1. Factors Influencing Water Supply Reliability

Water Supply Source	Water Quality	Climate Change	Environmental issues	Facility constraints
Raymond Basin Groundwater	X	X		X
Surface Runoff Diversion	X	X	X	X
Imported Water	X	X	X	X
Stormwater Harvesting	X	X	X	X
Recycled Water	X		X	X

5.3.1 Water Quality

As discussed in Section 4, PWP is taking actions to maintain reliability of its water supply as a result of water quality issues. Water quality has the ability to impact all five of PWP's supply sources as shown in Table 5-1. Both MWD and PWP have been proactive in addressing water quality issues before they impact supply reliability. Current and planned projects developed as part of the MWD's regional IRP and PWP's WIRP take into consideration known and unforeseen water quality impacts.

5.3.2 Climate Change

Section 7 discusses potential water reliability impacts that may occur as a result of climate change. Climate change can potentially impact surface runoff diversion, imported water availability, natural groundwater recharge, and stormwater harvesting. Implementation of PWP's WIRP provides mitigation and adaption measures designed to ensure reliability in light of potential climate change impacts.

5.3.3 Environmental Issues

In developing its WIRP, PWP has taken environmental issues into account when developing the preferred alternative. Environmental issues were defined in the WIRP as long-term impacts to habitat associated with aquatic life in local streams and restoration areas. MWD's regional IRP has also accounted for environmental issues in its water supply planning (see Section 4). Therefore, environmental issues are not expected to impact PWP's supply reliability.

5.3.4 Facility Constraints

As part of the WIRP, PWP has examined its facilities and identified constraints that may impact supply reliability if corrective measures are not taken. PWP is moving forward with the projects discussed in Section 4 to increase well capacity and treatment facilities so that full groundwater rights as well as stored water in the basin can be fully exercised.

5.3.5 Legal Constraints

PWP does not have known legal issues that will affect water supply reliability.

5.4 Water Reliability by Categorical Year Type

The water supply reliability assessment shown in Tables 5-2 through 5-4 presents comparisons of water supply and demand for three categories of hydrologic condition: normal, single dry year, and multiple dry years. Groundwater is based on the most recent RBMB resolution on water rights from the Raymond Basin. Natural replenishment to the groundwater basin varies with hydrology, but the ability to extract the water from the ground is more a function of long-term average recharge and is less subject to hydrologic variability from year to year. However, surface water diversions and stormwater harvesting (Devil's Gate Project) will have significant variations depending on hydrology.

Based on historical gage data for existing surface diversions and estimated capture of stormwater for the Devil's Gate Project, an estimate of supply yield was derived for historical hydrological conditions. Figure 5-1 presents this data from 1980-2009. The period 2002-2004 is considered representative of the worst three-year dry period for local water supplies. The year 2002 was used to represent a single dry year for local supplies. MWD water purchases during average years are not expected to be constrained and are therefore equal to the difference between water demands (with planned conservation) and local water supplies. During dry years, MWD water may be curtailed, but PWP's planned groundwater storage program will provide enough dry year supply to compensate for the reduced surface diversions and any potential shortfall in MWD water.

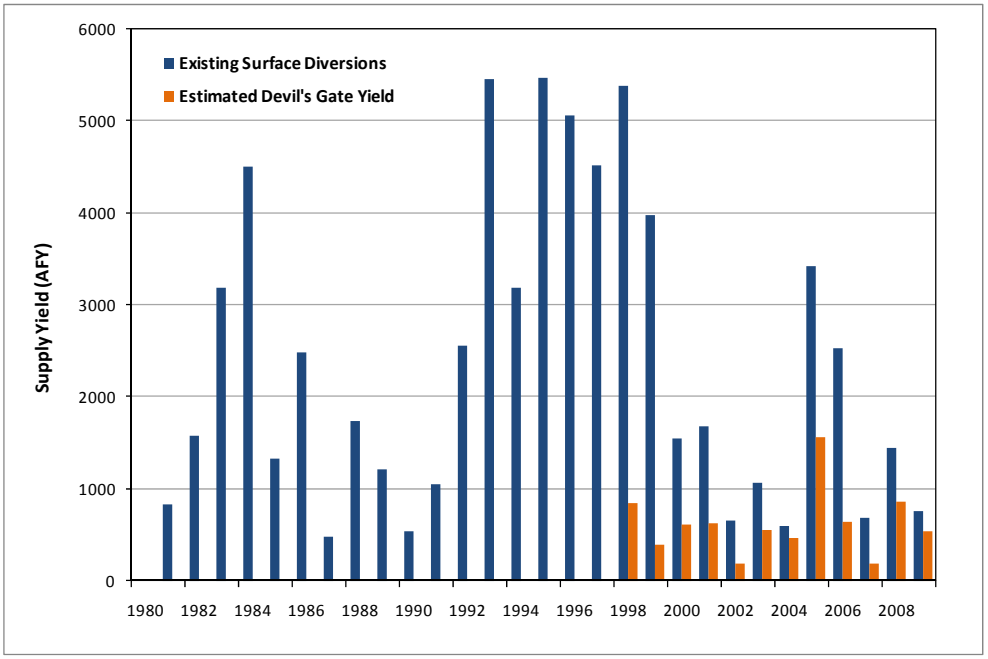

Figure 5-1. Historical Estimates of Surface Diversions for PWP

Table 5-2. Water Supply and Demand Comparison for a Normal Hydrologic Condition

Supply / Demand (AFY)	2010	2015	2020	2025	2030	2035
Existing Groundwater	12,056	10,304	10,304	10,304	10,304	10,304
Existing Surface Water Diversion	2,380	2,380	2,380	2,380	2,380	2,380
Imported Water from MWD	24,024	23,626	21,149	21,149	21,149	21,149
Planned Recycled Water	0	1,130	2,050	2,050	2,050	2,050
Planned Stormwater Harvesting	0	0	627	627	627	627
Planned Groundwater Storage Program	0	0	0	0	0	0
Total Supply	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**
Demand Projection w/o New Conservation[(1)]	38,460	39,940	41,510	42,490	43,010	43,380
Planned Water Conservation[(1)]	0	2,500	5,000	5,980	6,500	6,870
Total Demand	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**
Surplus/Shortage	0	0	0	0	0	0
Surplus/Shortage as % of Supply	0%	0%	0%	0%	0%	0%
Surplus/Shortage as % of Demand	0%	0%	0%	0%	0%	0%

[(1)] Data from Table 3-6.

Table 5-3. Water Supply and Demand Comparison for a Single-Year Dry Hydrologic Condition (2002)

Supply / Demand (AFY)	2010	2015	2020	2025	2030	2035
Existing Groundwater	12,056	10,304	10,304	10,304	10,304	10,304
Existing Surface Water Diversion	660	660	660	660	660	660
Imported Water from MWD	25,744	25,346	20,306	20,306	20,306	20,306
Planned Recycled Water	0	1,130	2,050	2,050	2,050	2,050
Planned Stormwater Harvesting	0	0	190	190	190	190
Planned Groundwater Storage Program	0	0	3,000	3,000	3,000	3,000
Total Supply	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**
Demand Projection w/o New Conservation	38,460	39,940	41,510	42,490	43,010	43,380
Planned Water Conservation	0	2,500	5,000	5,980	6,500	6,870
Total Demand	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**
Surplus/Shortage	0	0	0	0	0	0
Surplus/Shortage as % of Supply	0%	0%	0%	0%	0%	0%
Surplus/Shortage as % of Demand	0%	0%	0%	0%	0%	0%

Table 5-4. Water Supply and Demand Comparison for a Multiple-Dry Year Hydrologic Condition

Year	Supply / Demand (AFY)	2010	2015	2020	2025	2030	2035
First Year of Supply (2002)	Existing Groundwater	12,056	10,304	10,304	10,304	10,304	10,304
	Existing Surface Water Diversion	660	660	660	660	660	660
	Imported Water from MWD	25,744	25,346	20,306	20,306	20,306	20,306
	Planned Recycled Water	0	1,130	2,050	2,050	2,050	2,050
	Planned Stormwater Harvesting	0	0	190	190	190	190
	Planned Groundwater Storage Program	0	0	3,000	3,000	3,000	3,000
	Total Supply	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**
	Demand Projection w/o New Conservation	38,460	39,940	41,510	42,490	43,010	43,380
	Planned Water Conservation	0	2,500	5,000	5,980	6,500	6,870
	Total Demand	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**
	Surplus/Shortage	0	0	0	0	0	0
	Surplus/Shortage as % of Supply	0%	0%	0%	0%	0%	0%
	Surplus/Shortage as % of Demand	0%	0%	0%	0%	0%	0%
Second Year of Supply (2003)	Existing Groundwater	12,056	10,304	10,304	10,304	10,304	10,304
	Existing Surface Water Diversion	1,070	1,070	1,070	1,070	1,070	1,070
	Imported Water from MWD	25,334	24,936	18,526	18,526	18,526	18,526
	Planned Recycled Water	0	1,130	2,050	2,050	2,050	2,050
	Planned Stormwater Harvesting	0	0	560	560	560	560
	Planned Groundwater Storage Program	0	0	4,000	4,000	4,000	4,000
	Total Supply	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**
	Demand Projection w/o New Conservation	38,460	39,940	41,510	42,490	43,010	43,380
	Planned Water Conservation	0	2,500	5,000	5,980	6,500	6,870
	Total Demand	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**
	Surplus/Shortage	0	0	0	0	0	0
	Surplus/Shortage as % of Supply	0%	0%	0%	0%	0%	0%
	Surplus/Shortage as % of Demand	0%	0%	0%	0%	0%	0%
Third Year of Supply (2004)	Existing Groundwater	12,056	10,304	10,304	10,304	10,304	10,304
	Existing Surface Water Diversion	600	600	600	600	600	600
	Imported Water from MWD	25,804	25,406	18,086	18,086	18,086	18,086
	Planned Recycled Water	0	1,130	2,050	2,050	2,050	2,050
	Planned Stormwater Harvesting	0	0	470	470	470	470
	Planned Groundwater Storage Program	0	0	5,000	5,000	5,000	5,000
	Total Supply	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**
	Demand Projection w/o New Conservation	38,460	39,940	41,510	42,490	43,010	43,380
	Planned Water Conservation	0	2,500	5,000	5,980	6,500	6,870
	Total Demand	**38,460**	**37,440**	**36,510**	**36,510**	**36,510**	**36,510**
	Surplus/Shortage	0	0	0	0	0	0
	Surplus/Shortage as % of Supply	0%	0%	0%	0%	0%	0%
	Surplus/Shortage as % of Demand	0%	0%	0%	0%	0%	0%

Imported water demands from 2010 to 2035 for each of the hydrologic conditions presented in Tables 5-2 through 5-4 were provided to MWD.

In addition to the planned water conservation and water supplies shown in Tables 5-2 through 5-4, PWP's WIRP has identified additional water conservation and potential stormwater capture that could be implemented in future years if needed (see Table 5-5).

Table 5-5. Other Potential Supply Options for PWP

Potential Options	Potential Yield Beyond Planned Amounts (AFY)
Additional Water Conservation	Up to 2,130
Stormwater Capture: Cisterns, Bioswales, Rain Gardens, Permeable Pavement	130 (1)

(1) A stormwater master plan has been recommended as part of the WIRP to determine the cost/benefit of this and more thoroughly evaluate the potential supply yield.

5.5 Water Shortage Contingency Plan

The purpose of the water shortage contingency plan is to be prepared if water supplies fall below expected water demands by imposing temporary water demand restrictions. Water supplies may be below the planned levels due to extreme (or worst case) drought conditions, unplanned outages of local and imported water supply facilities due to earthquakes or other major disasters, prolonged power outages, water contamination, or any other catastrophic loss of supply.

The City adopted its first water supply shortage plan in 1988, which was most recently revised on June 1, 2009. The City's water shortage plan is located in the City of Pasadena's municipal code in Chapter 13.10 titled "Water Waste Prohibitions and Water Supply Shortage Plans". Appendix G contains a copy of the ordinance. The plans list mandatory water use prohibitions regardless of water supply availability and provides for emergency water demand management for supply shortages due to severe droughts, infrastructure failure, or any other cause.

5.5.1 Driest Three-Year Supply

Table 5-6 provides an estimate of the minimum water supply from each source that may be available to PWP during each of the next three years, based on the local hydrology for the years 2002-2004.

Table 5-6. Estimated Minimum Water Supply Over the Next Three Years

Water Supply Source	Normal Hydrologic Year Condition (AFY)	Minimum Water Supply Scenario (AFY)		
		2011	2012	2013
Existing Groundwater (1)	12,807	12,056	11,556	11,056
Existing Surface Water Diversion (2)	2,380	661	1,073	600
Imported Water from MWD (3)	25,000	22,500	22,500	22,500
Total	**40,187**	**35,217**	**35,129**	**34,156**

(1) Normal hydrologic year groundwater represents PWP's original judgement before RBMB issued a resolution to reduce pumping by 30%.
(2) From Table 5-4
(3) Normal hydrologic year MWD water represents average PWP purchases from 1990-2008, without MWD's recent curtailment of imported water

During severe drought periods PWP's imported water supplier, MWD, may use an allocation strategy that is consistent with the framework developed in its Water Surplus and Drought Management (WSDM) Plan. Developed by MWD with substantial input from its member agencies, the WSDM Plan provides for a needs-based allocation strategy, and establishes priorities for the use of MWD's water supplies to achieve 100 percent retail reliability. Furthermore, in 2008 MWD adopted a Water Supply Action Plan (WSAP) to allocate supplies among its member agencies in a fair and efficient manner during shortages. The WSAP establishes the formula for calculating member agency allocation if MWD cannot meet firm demands in a given year.

5.5.2 Catastrophic Supply Interruption Plan

PWP is also prepared for a catastrophic event that would result in complete loss of supply from its normal sources. It is likely that a complete loss of supply would be short-term, lasting from a day to a week or so, until some reduced supply is restored from normal sources. Major catastrophic events that may affect PWP's major water sources are extreme (worst case) drought, earthquake, region-wide power outage, contamination or loss of imported water. To prepare for potential catastrophic events PWP has developed an emergency response plan and contingency plan to respond to supply interruptions, operates a water quality control laboratory to ensure rapid testing of water quality, continuously implements security upgrades, has back-up power and communications equipment, and has developed points of contacts and chains of command during emergency situations.

Additionally, PWP is prepared to deal with secondary effects of emergency events, such as a loss of power, decline in water quality, or a communication system shutdown. PWP's emergency planning procedures are designed to maintain safe water supplies to meet basic customer needs and reduce the impacts of any catastrophic supply interruptions to the greatest extent possible.

Emergency response plans for PWP if a catastrophic event impacts the ability of PWP to deliver water are described below in Table 5-7.

Table 5-7. Possible Actions for Catastrophic Events

Type of Catastrophe	Response Actions
Extreme Drought	1. City Council enacts Level 4 water supply shortage water conservation measures
	2. Determination by Council if additional water conservation measures are needed to achieve necessary reductions in demand.
Earthquake	1. If power is lost use alternative means of inter-PWP communications.
	2. If power is lost restore localized power to critical facilities (pumps, boosters, and water treatment facilities.
	3. Inspect reservoirs, boosters, pumps, and wells for structural damage.
	4. Recommend water boiling.
	5. City council enacts Level 4 water supply shortage water conservation measures.
	6. Determination by City Council if additional water conservation measures are needed to achieve necessary reductions in demand.
	7. Check with neighboring agencies if supplies are available using emergency interconnections
	8. Establish and maintain communications with MWD.
Region-Wide Power Outage	1. Use alternative means of inter-PWP communications.
	2. Restore localized power to critical facilities (pumps, boosters, and water treatment facilities).
	3. Recommend water boiling.
	4. City council enacts Level 4 water supply shortage water conservation measures.
	5. Determination by City Council if additional water conservation measures are needed to achieve necessary reductions in demand.
	6. Check with neighboring agencies if supplies are available using emergency interconnections
	7. Establish and maintain communications with MWD.
Water Contamination	1. Recommend water boiling.
	2. Consider increasing disinfection of water.
	3. Check with neighboring agencies if uncontaminated supplies are available using emergency interconnections
	4. Establish and maintain communications with MWD.
Loss of Imported Water	1. City Council enacts Level 4 water supply shortage water conservation measures.
	2. Determination by City Council if additional water conservation measures are needed to achieve necessary reductions in demand.
	3. Check with neighboring agencies if supplies are available using emergency interconnections
	4. Establish and maintain communications with MWD.

5.5.3 Mandatory Water Use Prohibitions

The Act requires water agencies to plan for varying levels of temporary or prolonged shortages of up to 50 percent of normal supplies regardless of whether it may or may not happen. The City's plan provides for four stages or levels of implementation, as referred to in the City's municipal code, which include specific water use reduction requirements and prohibited water uses, as shown in Table 5-8. These stages of action assume that there may be reduced supplies from PWP's normal sources, under conditions that may be months in duration. Regardless of a water shortage, water waste prohibitions are in effect at all times. These prohibited uses are intended to eliminate water wasting and increase public awareness of the need to conserve water. Additionally, public information and education to promote water conservation are continuously provided by PWP regardless of a water shortage.

Table 5-8. Water Shortage Contingency Levels of Action

Level	Reduction Range (%)	Type	Water Use Prohibitions	Penalties for Excessive Water Use
Ongoing	0	Mandatory	No watering of lawn, landscape, or other vegetated areas between 9 a.m. and 6 p.m., expect with a hand-held container, hand-held hose with equipped with a water shut-off nozzle or device, or for very short periods of time with the purpose of adjusting or repairing an irrigation system	Yes
			No water during periods of rain	
			No washing down hard or paved surfaces unless for safety or sanitation, in which case a bucket, a hose with a shut-off nozzle, a cleaning machine that recycles water, or a low-volume/high pressure water broom is used	
			All property owners shall fix leaks, breaks, or malfunctions when identified or within seven days of receiving a notice from PWP	
			Fountains and water features must have a re-circulating system	
			Vehicles must be washed with a hand-held bucket and/or hose equipped with a water shut-off nozzle, expect for vehicles washed at commercial car wash facilities	
			Restaurant may only serve water upon request and must use water-saving dish spray valves for cleaning	
			Non-recirculating water systems may not be installed at commercial car washes and laundry systems. All commercial car washes as of July 1, 2011 must use a recirculating water system or obtain a waiver.	
			Commercial lodging facilities must give guests the option to decline daily bed linen and towel changes. Facilities must display notice of the option in each bathroom.	
			Installation of single pass cooling systems is prohibited in buildings requesting new water service.	
1	0-15	Mandatory	Watering restricted to three days per week from April 1 through October 31 and no more than 1 day per week from November 1 through March 31 on a schedule posted by PWP. This restriction does not apply to landscape irrigation zones that exclusively use low flow drip irrigation systems where no emitters exceed two gallons per hour; watering using hand-held container, hand-held hose with equipped with a water shut-off nozzle or device; for very short periods of time with the purpose of adjusting or repairing an irrigation system; or for maintenance of vegetation, including fruits trees and shrubs, intended for consumption.	Yes
			All property owners shall fix leaks, breaks, or malfunctions within 72 hours of receiving a notice from PWP unless other arrangements are made.	
2	15-20	Mandatory	Watering restricted to two days per week from April 1 through October 31 and no more than 1 day per week from November 1 through March 31 on a schedule posted by PWP. This restriction does not apply to landscape irrigation zones that exclusively use low flow drip irrigation systems where no emitters exceed two gallons per hour; watering using hand-held container, hand-held hose with equipped with a water shut-off nozzle or device; for very short periods of time with the purpose of adjusting or repairing an irrigation system; or for maintenance of vegetation, including fruits trees and shrubs, intended for consumption.	Yes
			All property owners shall fix leaks, breaks, or malfunctions within 48 hours of receiving a notice from PWP unless other arrangements are made.	
			Filling or re-filling ornamental lakes or ponds is prohibited, expect where necessary to sustain aquatic life.	

Level	Reduction Range (%)	Type	Water Use Prohibitions	Penalties for Excessive Water Use
3	20-35	Mandatory	Watering restricted to one day per week on a schedule posted by PWP. This restriction does not apply to the following categories of use as determined by PWP: - Landscape irrigation zones where no emitters exceed 2 gallons per hour; - Watering using hand-held container, hand-held hose with equipped with a water shut-off nozzle; - Watering for very short periods of time with the purpose of adjusting or repairing an irrigation system; - Maintenance of vegetation, including fruits trees and shrubs, intended for consumption; - Maintenance of existing landscape necessary for fire protection or soil erosion control; - Maintenance of plant materials identified to be rare or essential to the well-being of protected species; - Maintenance of landscape within active parks and playing fields, school grounds, golf course greens, and day care centers according to a schedule posted by PWP; and - Actively irrigated environmental mitigation projects.	Yes
			All property owners shall fix leaks, breaks, or malfunctions within 36 hours of receiving a notice from PWP unless other arrangements are made.	
			Filling or re-filling ornamental lakes or ponds is prohibited, expect where necessary to sustain aquatic life.	
4	35-50	Mandatory	No watering or irrigation. This restriction does not apply to the following categories of use as determined by PWP: - Maintenance of vegetation, including fruits trees and shrubs, intended for consumption; - Maintenance of existing landscape necessary for fire protection or soil erosion control; - Maintenance of plant materials identified to be rare or essential to the well-being of protected species; - Maintenance of landscape within active parks and playing fields, school grounds, golf course greens, and day care centers provided that such irrigation does not exceed two days per week, according to a schedule posted by PWP; and - Actively irrigated environmental mitigation projects.	Yes
			All property owners shall fix leaks, breaks, or malfunctions within 24 hours of receiving a notice from PWP unless other arrangements are made.	
			Filling or re-filling ornamental lakes or ponds is prohibited, expect where necessary to sustain aquatic life.	
			Refilling of more than one foot or initially filling pools or outdoor spas is prohibited.	
			No new potable water service will be provided, no new temporary or permanent meters will be provided, and no statements of immediate availability to service or provide potable water service will be issued, except under the following conditions: - A valid unexpired building permit has been issued; - The project is necessary to protect the public health, safety, and welfare; or - The applicant provides substantial evidence of an enforceable commitment that water demands for the project will be offset prior to the provision of new water meter(s) to the satisfaction of PWP.	

If a water shortage occurs, PWP recommends to the City Council the appropriate level for implementation corresponding to the degree of the shortage given projected supplies and demands. Next a public hearing is held by the City Council to determine 1) if a water shortage exists; 2) the necessary water conservation target needed to address the shortage; and 3) the appropriate level to implement to address the shortage. Implementation of a level occurs immediately upon publication of the City Council's decision. During the water shortage the City Council may discontinue levels or implement any other levels. After the City Council determines a water shortage is no longer in effect, the water shortage level in effect shall be terminated.

5.5.4 Penalties for Violations of Prohibited Water Uses

Violation of the water use prohibitions range from a written notice for a first violation to monetary penalties for subsequent violations as shown in Table 5-9. Monetary penalties vary based on meter size, customer classification, and the number of fines within a twelve month period ranging from $100 to $500 for residential customers and customers with meters less than one-inch. Fines range from $200 to $1,000 for non-residential customers with meters one-inch or larger. Monetary penalties are collected by adding the fine to a customer's bill and are payable at the same time and in the same manner as such bill or by any other method of collection and payment established by PWP. After receiving notice of an alleged violation, customers have the right to a hearing by the General Manager of PWP.

Table 5-9. Penalties for Violating Water Use Prohibitions

Number of Violations in a 12-Month Period	Penalty	
	Residential and all meters less than 1-inch	Non-Residential meters 1-inch and larger
1	Written notice	Written notice
2	$100	$200
3	$200	$400
4	$350	$700
5 and subsequent violations	$500	$1,000

As an alternative to paying a fine, a customer, with the concurrence of the General Manager, may waive the right to a hearing and elect one of the options in lieu: 1) complete a water efficiency training class offered by PWP; 2) complete all recommendation presented in a landscape audit 3) retrofit inefficient fixtures or irrigation systems; and/or 4) timely complete such other water savings programs as PWP may establish for the customer. A timetable shall be established for completing the selected option jointly by the customer and PWP. If a customer fails to complete the option to the satisfaction of PWP or within the given timeframe, then the customer must pay the monetary penalty. A customer may not select the same option more than once in a twelve month period.

If necessary to achieve compliance with the water prohibitions, the ordinance allows to PWP to install flow restrictors of one gallon per minute for services up to one-inch meters and comparably sized restrictors for larger meters with a minimum 48 hours advance notice. A customer is responsible for the cost of installation and removal of any water flow restrictors with payment due prior to removal of the restrictor. Service may be discontinued for continuing or willful violations of the ordinance in addition to any penalties and/or the installation of a water flow restrictor.

As amended, the ordinance also allows the General Manager of PWP to request water conservation plans and quarterly follow-up reports from commercial and industrial water users using 25,000 billing units or more per year. Plans must include recommendations for conserving water and progress to date in implementing water savings.

5.5.5 Revenue and Expenditure Impacts

The Act requires an analysis of impacts on a water supplier's revenues and expenditures from a water shortage that reduces water use. One concern is that reduced water consumption may result in reduced revenues. Another concern is that there may be higher costs to operate the system due to the shortage (e.g., if it is necessary to hire additional staff, purchase emergency short-term supplies at higher costs than normal supplies, make computer program modifications for billing, or increased public information costs).

PWP anticipates revenues will be lower during a drought as a result of a decrease in water sales. PWP maintains a cash reserve equal to approximately 60 to 90 days worth of revenue. During droughts PWP can also modify its rate structure to recover costs by adding a surcharge or initiating a cost of service study. A cost of service study would provide justification for water rate structure revisions if the study indicated costs of providing water service during a drought were not being recovered.

5.5.6 Mechanisms to Determine Water Use Reductions

PWP uses multiple methods to account for water use under normal conditions. Water supply conditions are recorded on a daily basis. Well production, MWD imported water, and spreading water are calculated and recorded by the Water Engineering Division. Data is rolled into monthly production totals and submitted to the Water Engineering Manager and added to the water supply report. All data is stored on PWP's network and is accessible by all employees with access to the network. PWP also has a Supervisory Control Data and Acquisition (SCADA) system that produces instantaneous data and logs data in the system.

During shortage scenarios a spreadsheet is used to compare current weekly production with projected weekly base demand. The spreadsheet is provided to the Water Engineering Manager for analysis and verification of demand reduction. Monthly reports, similar to normal operating conditions, are presented to the General Manager for review. If the General Manager determines water demand reduction goals are not being met, the General Manager will notify the City Council. Ultimately, the City Council will take corrective actions as necessary to adjust the water shortage emergency level to increase conservation. If dictated by the type of emergency situation, production figures can be reported to the Water Engineering Manager on an hourly basis and the General Manager and subsequently the City Council on weekly basis.

This page intentionally left blank.

Section 6
Water Demand Management Measures

6.1 Law

California Water Code Section:

10631. A plan shall be adopted in accordance with this chapter and shall do all of the following:

10631 (f) Provide a description of the supplier's water demand management measures. This description shall include all of the following:

10631 (f) (1) A description of each water demand management measure that is currently being implemented, or scheduled for implementation, including the steps necessary to implement any proposed measures, including, but not limited to, all of the following:

(A) Water survey programs for single-family residential and multifamily residential customers

(B) Residential plumbing retrofit

(C) System water audits, leak detection, and repair

(D) Metering with commodity rates for all new connections and retrofit of existing connections

(E) Large landscape conservation programs and incentives

(F) High-efficiency washing machine rebate programs

(G) Public information programs

(H) School education programs

(I) Conservation programs for commercial, industrial, and institutional accounts

(J) Wholesale agency programs

(K) Conservation pricing

(L) Water conservation coordinator

(M) Water waste prohibitions

(N) Residential ultra-low-flush toilet replacement programs

10631 (f) (2) A schedule of implementation for all water demand management measures proposed or described in the plan.

10631 (f) (3) A description of the methods if any, that the supplier will use to evaluate the effectiveness of water demand management measures implemented or described under the plan.

10631 (f) (4) An estimate, if available, of existing conservation savings on water use within the supplier's service area, and the effect of such savings on the supplier's ability to further reduce demand.

10631 (g) An evaluation of each water demand management measure listed in paragraph (1) of subdivision (f) that is not currently being implemented or scheduled for implementation. In the course of the evaluation, first consideration shall be given to water demand management measures, or combination of measures, which offer lower incremental costs than expanded or additional water supplies. This evaluation shall do all of the following:

10631 (g) (1) Take into account economic and noneconomic factors, including environmental, social, health, customer impact, and technological factors.

10631 (g) (2) Include a cost-benefit analysis, identifying total benefits and total costs.

10631 (g) (3) Include a description of funding available to implement any planned water supply project that would provide water at a higher unit cost.

10631 (g) (4) Include a description of the water supplier's legal authority to implement the measure and efforts to work with other relevant agencies to ensure the implementation of the measure and to share the cost of implementation.

10631 (h) Urban water suppliers that are members of the California Urban Water Conservation Council and submit annual reports to the council in accordance with the "Memorandum of Understanding Regarding Urban Water Conservation in California," dated September 1991, may submit the annual reports identifying water demand management measures currently being implemented, or scheduled for implementation, to satisfy the requirements of subdivisions (f) and (g).

6.2 Overview of Implementation Status

PWP has continuously implemented a water conservation program since 1991 with an estimated aggregate water savings of over 59,620 AFY. In the WIRP, PWP estimated there is potential to achieve additional conservation beyond existing conservation levels (see Sections 3 and 5). PWP is a signatory to the Memorandum of Understanding Regarding Urban Water Conservation in California, dated December 10, 2008, through the CUWCC. Table 6-1 lists the current implementation status for each of the DMMs required by the Urban Water Management Planning Act and corresponding water conservation BMPs required for CUWCC members. This section summarizes the implementation status of the DMMs based on the 2007/2008 annual report filed with the CUWCC. In addition to the summaries provide in this section, Appendix H contains the City's 2009/2010 annual report regarding implementation of the CUWCC BMPs.

Table 6-1. Summary of Demand Management Measure Implementation

DMM #/BMP # - Name	Implementation Status
A/3.1 — Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers	Fully implemented
B/3.1 — Residential Plumbing Retrofits	Fully implemented
C/1.2 — System Water Audits, Leak Detection, and Repair	Fully implemented
D/3 — Metering with Commodity Rates	Fully implemented
E/5 — Large Landscape Conservation Programs	Fully implemented
F/3.3 – High-Efficiency Washing Machine Rebate Programs	Fully implemented
G/2.1 — Public Information Programs	Fully implemented
H/2.2 — School Education Programs	Fully implemented
I/4 — Conservation Programs for CII Accounts	Fully implemented
J/1.1.3 — Wholesale Agency Programs	Not applicable
K/1.4 — Conservation Pricing	Fully implemented
L/1.1.1 — Water Conservation Coordinator	Fully implemented
M/1.1.2 — Waste Water Prohibition	Fully implemented
N/3.4 — Residential Ultra-Low-Flush Toilet Replacement Programs	Fully implemented

6.3 Summary of Implemented DMMs

The following sections describe PWP's implementation of these DMMs.

6.3.1 Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers (DMM A)

This measure involves offering water conservation surveys to not less than 20 percent of single- and multi-family residential customers every two years, and completing surveys for not less than 15 percent of single- and multi-family residential customers within 10 years of program initiation. PWP would need to complete more than 430 single-family surveys and over 63 multi-family surveys annually over the next 10 years.

These water audits are essentially one-on-one public education efforts. Other agencies have found that the savings from water audits, whether residential or commercial, typically last for about a 3-year period, and then must be repeated due to owner/staff turnover.

PWP offers single-family residential and multi-family residential water audits. Single-family audits are typically offered as a result of high bill complaints and other special circumstances. Multi-family audits are offered via a direct-mail program focusing on outdoor water use. In 2008, PWP offered approximately 300 single-family residential surveys and 135 multi-family surveys and completed eighteen and eight surveys, respectively. PWP estimates annual savings of 57 AFY attributed to this DMM.

Surveys can consist of indoor and/or outdoor surveys. Indoor surveys identify opportunities for installing hardware based water conservation devices and provide leak detection tests and an assessment/inventory of water fixtures. Low flow showerheads and aerators are also distributed when available. Outdoor surveys review irrigation schedules and practices to determine if overwatering is occurring. In 2009, PWP initiated Phase 2 of its pilot landscaping audit program targeting multi-family and large residential properties greater than 1 acre. Phase 1 targeted commercial customers. As part of the survey process customers are

given an information packet focusing on water conservation, an evaluation is performed by a certified landscape professional, and a list of recommended actions is provided.

In recent years the program has been supplemented with online programs including California friendly landscaping classes, self-conducted indoor and outdoor residential audits via H2ouse.com, and "How To" video segments are under development for installing and programming a weather-based irrigation controller, rotating sprinklers, drip irrigation, and avoiding runoff. PWP additionally offers landscaping workshops with Spanish translations available.

6.3.2 Residential Plumbing Retrofits (DMM B)

The purpose of this measure is to make available low-flow showerheads, aerators, toilet displacement devices, and other water savings fixtures or devices to single- and multi-family residences constructed prior to 1992 when building standards were modified to require water saving fixtures in new construction. This measure would require that PWP distribute these devices to not less than 10 percent of their single- and multi-family customers every two years until such time PWP can demonstrate that at least 75 percent of residences constructed prior to 1992 have been retrofitted.

Beginning in 1991 PWP first began distributing low flow water use fixtures. Currently, it is estimated that low flow showerheads have been installed in 90% of single-family residences and 88% of multi-family residences. PWP estimates this program provides annual savings of 143 AFY.

PWP continues to encourage use of low flow fixtures through community events and distribution programs. PWP distributes water conservation buckets at education events and during water surveys. Included within the buckets are low flow showerheads (1.5 gpm with shut off levers) aerators for kitchen and bathroom faucets. PWP also provides toilet leak detection tablets. In 2008 PWP distributed the following low flow fixtures to single-family residences: 574 low flow showerheads, 35 toilet displacement devices, and 625 faucet aerators. In 2008 PWP distributed the following low flow fixtures to multi-family residences: 246 low flow showerheads, 190 toilet displacement devices, and 128 faucet aerators.

6.3.3 System Water Audits, Leak Detection and Repair (DMM C)

This measure requires water suppliers to conduct audits of the water system consistent with AWWA guidelines if unaccounted-for water exceeds 10 percent.

PWP annually conducts system water audits by comparing the total volume of billed water use to the total supply entering the system. Unaccounted for water in PWP's system averaged 7.7 percent between 2005 and 2008. Significant differences exceeding 10 percent would indicate the need for repairs.

6.3.4 Metering with Commodity Rates (DMM D)

Less than 1 percent, or less than 400, of PWP's accounts are not metered. All new accounts established require a water meter. Customer billing is based on volume of use. PWP's current rate structure promotes conservation through an increasing tier block rate design with unit prices varying between the winter and summer seasons.

6.3.5 Large Landscape Conservation Programs (DMM E)

This measure consists of three parts focusing on CII customers with large landscape irrigation needs. The first part requires developing evapotranspiration (ET)-based water budgets for accounts with dedicated irrigation meters. Water budgets cannot equal more than an average of 70% of the annual average local reference ET per square foot of landscape area. Budgets must be developed at an average rate of 9 percent per year over ten years, or 26 budgets per year in PWP's service area, so budgets are developed for 90

percent of dedicated irrigation meter accounts within ten years of implementation. PWP currently has approximately 326 irrigation meters and is in the process of developing water-based budgets. Upon completion, notices are required to be provided with each billing cycle showing the water consumed versus the budget. Within 6 years of implementation, PWP must annually provide site-specific technical assistance to all customers exceeding their budgets by 20 percent or more.

On September 10, 2009, the State of California released an update to its Model Water Efficient Landscape Ordinance as a standard for implementation in communities without landscape ordinances concerning water use. The ordinance provides water conservation requirements for most new development and redevelopment projects and retrofit requirements for existing large landscape properties with an area of one acre or greater and cemeteries. Requirements for existing large landscape properties include, but are not limited to, irrigation water use analyses, irrigation surveys, and irrigation audits to evaluate water use and provide recommendations as necessary to reduce landscape water use to a level that does not exceed the Maximum Applied Water Allowance (MAWA) for existing landscapes. The MAWA is a function of ET rates for the area. PWP adopted the Model Water Efficient Landscape Ordinance on June 14, 2010 and will enforce the provisions on all new, redevelopment, and retrofit projects as required.

The second part involves providing large landscape surveys to not less than 15 percent of commercial, industrial, and institutional (CII) accounts with mixed-use meters within 10 years of program initiation. PWP has 3,820 commercial/institutional and industrial meters. PWP has provided landscape water use surveys to over 700 of these customers since 1999 exceeding the 15 percent target.

In 2008 PWP initiated a large landscape pilot program. This program provides free outdoor water audits provided by two certified landscape professionals. Phase 1 targeted the top 100 largest CII customers for participation. As of December 2008, 43 customers were contacted and 36 surveys were completed with landscape efficiency measures implemented at 29 sites. Water savings as a result of this initial phase are estimated at 245 to 255 AFY. PWP also encourages large landscape conservation through its public information program as discussed in sub-section 6.3.7.

The third part requires offering financial incentives to support parts 1 and 2. PWP provides rebates for landscape irrigation system improvements for CII customers and multi-family residences with five or more units through MWD's Save Water Save a Buck Program. As specified in Table 6.2 in subsection 6.3.9, landscape rebates are provided for weather based irrigation controllers (WBIC), central computer irrigation controllers, retrofit rotating nozzles for pop-up spray heads, and high efficiency nozzles for large rotary sprinklers. The Save Water Save a Buck Program is discussed in more detail in sub-section 6.3.9. In 2008, customers had installed three WBICs and PWP has directly installed 53 rotating nozzles.

6.3.6 High-Efficiency Washing Machine Rebate Programs (DMM F)

This measure calls on water suppliers to offer cost-effective rebates to their customers for the purchase of high-efficiency washing (HEW) machines. In 2008 MWD initiated the SoCal Water$mart Program for residential water conservation replacing previous rebate programs offered by individual water service providers throughout the MWD service area. This program sponsored by MWD sets uniform rebate requirements across the MWD service area and provides a clearinghouse for processing rebates for all MWD member agency customers. Local agencies have the option of increasing baseline rebate amounts to their customers through the program. PWP has increased baseline rebates for a few of the qualifying products, including high efficiency washing machines. Eligible customers include residential customers residing in single-family and multi-family homes, even if multi-family residents do not receive a water bill.

Currently rebates are $85 per washing machine with a water factor of 4.0 or less, however, PWP has increased the baseline rebate offered by MWD by an additional $65 for a total rebate of $150. In 2008 637

devices were installed in PWP's service area and over 3,900 have been installed since 2002. Water savings attributed to HEW are estimated at 61 AFY.

6.3.7 Public Information Programs (DMM G)

PWP has an active public information program based on the premise that providing customers with pertinent information will lead to more efficient water use in the service area. PWP provides outreach to both the CII and residential customer sectors using presentations, advertising, and maintaining an online website dedicated to conservation. PWP works closely with neighboring water agencies, Burbank and Glendale, to create consistent regional water conservation messages.

Workshops, presentations, and outreach have provided residents and businesses with hands on demonstrations. During the period of November 2007 and January 2009, PWP participated in 71 various outreach events including community events, town hall meetings, and business forums. During the same period, PWP offered 17 workshops with 520 customers participating. Workshops have been conducted by a variety of professionals, a landscape supply business, and a renowned horticulturist. At all events water conservation materials and information on PWP's Water Shortage Ordinance are provided in the form of handouts. Workshops topics have included:

- Presentations to Homeowners associations, neighborhood associations, and business organizations
- Efficient irrigation
- Water smart garden workshops using drought tolerant and native landscaping
- Healthy trees and shrubs workshops
- Professional landscaping classes
- Native Nights
- California friendly landscaping

PWP has developed an online presence to encourage its customers to conserve water via a dedicated website at PasedenaSavesWater.com. The website provides water shortage and conservation news, upcoming workshops, rebate announcements, conservation tips, self audits, a link to report water waste, and conservation tools and resources providing links to external water conservation websites.

Other mediums PWP utilizes to increase water conservation awareness include bill inserts, newsletters, press releases, welcome kits for new customers, monthly customer recognition in the monthly business newsletter *The Conduit*, advertising in newspapers and magazines, radio spots, local access television, and video monitors at the City's Permit Center.

6.3.8 School Education Programs (DMM H)

PWP first implemented school education programs in 1999. Upon request, PWP provides water-related class presentations for students in grades K through 12 and distributes educational materials to public schools. For students in 4th through 6th grade PWP hosts an annual water awareness event. At class presentations and events water conservation messages are distributed using age appropriate materials including coloring books, pens, pencils, and stuffed toys. PWP also provides field trips to students to its water quality laboratory and reservoirs. In 2008, 28 class presentations were held and approximately 2,000 students were reached in grades K through 12.

6.3.9 Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts (DMM I)

This measure requires water suppliers to implement water conservation measures for CII customers to achieve a 10 percent water savings for the CII sector as a whole using 2008 as a baseline over a 10 year period. In 2008 baseline water use for the CII sector was approximately 10,000 AF.

PWP, in partnership with MWD, has implemented a commercial rebate program, Save Water Save a Buck Program, designed specifically for customers in the CII sector and multi-family residences with five or more units represented by a homeowners association. The Save Water Save a Buck Program was launched in 2001 to provide menu-based rebates for water conserving measures applicable to many types of CII facilities. In the CII sector the program provides rebates for water saving plumbing fixtures, medical/dental equipment, food service equipment, and landscaping equipment. Current CII rebates are listed in Table 6-2. Within the multi-family sector, the program provides rebates for high efficiency washers, HETs, and landscape equipment. As of 2008, PWP estimates 6,054 CII conservation devices have been installed saving approximately 702 AFY.

Table 6-2. Current Commercial/Industrial/Institutional Rebates

Device Type	Rebate Amount
High Efficiency Toilets (1.28 gpf or less)	$50 each ($30 new construction)
Zero and Ultra Low Water Urinals	$200 each ($60 upgrade and new construction)
Cooling Tower pH Conductivity Controller	$1,750 each
Cooling Tower Conductivity Controller	$625 each
Air Cooled Ice Machine	$300 each
Connectionless Food Steamer	$485 compartment
Dry Vacuum Pump (maximum 2.0 horsepower)	$125 per 0.5 horsepower
Steam Sterilizer	1,900
Water Broom	$110 each
Weather Based Irrigation Controller	$25 per station
Central Computer Irrigation Controller	$25 per station
Rotating Nozzles for Pop-up Spray Heads (25 minimum)	$5 each
High Efficiency Spray Nozzles for Large Rotary Sprinklers	$10- per set

6.3.10 Wholesale Agency Programs (DMM J)

This measure is not applicable since PWP is not a wholesale water agency.

6.3.11 Conservation Pricing (DMM K)

PWP's current water rates, effective July 15, 2010, use a conservation pricing structure with an increasing tier block rate design and varying seasonal unit prices. Summer rates are in effect from April 1 through September 30 and winter rates are in effect from October 1 through March 31.

6.3.12 Water Conservation Coordinator (DMM L)

PWP has a designated water conservation coordinator who is certified through the American Water Works Association as a Water Conservation Practitioner. This position was initially created in 2001 and is solely

dedicated to water conservation issues. The water conservation coordinator is responsible for developing and implementing PWP's conservation programs and initiatives.

6.3.13 Water Waste Prohibition (DMM M)

The City has an ordinance for emergency water conservation planning that incorporates water waste prohibitions consistent with implementation of DMM M. PWP's Water Shortage Procedures were amended on July 4, 2009. The amendment includes permanent water waste prohibitions and prohibitions associated with four levels of water shortage conditions as discussed in Section 5.6. Permanent Water Waste Prohibitions, which apply at all times, include:

- No watering of lawn, landscape, or other vegetated areas between 9 a.m. and 6 p.m., expect with a hand-held container, hand-held hose with equipped with a water shut-off nozzle or device, or for very short periods of time with the purpose of adjusting or repairing an irrigation system.
- No water during periods of rain.
- No watering or irrigating in a manner that causes or allows excessive water flow or runoff onto an adjoining sidewalk, driveway, street, alley, gutter, or ditch.
- No washing down hard or paved surfaces unless for safety or sanitation, in which case a bucket, a hose with a shut-off nozzle, a cleaning machine that recycles water, or a low-volume/high pressure water broom is used.
- All property owners shall fix leaks, breaks, or malfunctions when identified or within seven days of receiving a notice from PWP.
- Fountains and water features must have a re-circulating system.
- Vehicles must be washed with a hand-held bucket and/or hose equipped with a water shut-off nozzle, expect for vehicles washed at commercial car wash facilities.
- Restaurant may only serve water upon request and must use water-saving dish spray valves for cleaning.
- Non-recirculating water systems may not be installed at commercial car washes and laundry systems. All commercial car washes as of July 1, 2011 must use a recirculating water system or obtain a waiver.
- Commercial lodging facilities must give guests the option of to decline daily bed linen and towel changes. Facilities must display notice of the option in each bathroom.
- Installation of single pass cooling systems is prohibited in buildings requesting new water service.

Violation of the permanent water waste prohibitions are discussed in Section 5.6.

6.3.14 Residential Ultra-Low-Flush Toilet (ULFT) Replacement Programs (DMM N)

This measure requires water suppliers to either implement a ULFT (meeting WaterSense specifications of 1.28 gallons per flush (gpf)) distribution program that is at least as effective as requiring retrofit of existing residential high-flow toilets with toilets meeting WaterSense specifications or less upon property resale until 2014 or a market saturation of 75% is demonstrated, whichever is sooner. MWD's SoCal Water$mart

program for ULFT for single-family residences has been discontinued as a result of market saturation in the MWD service area, although some agencies continue to offer rebates through the program by providing funding to MWD. PWP has estimated ULFT saturation of approximately 90 percent in its service area for single-family residences. As a result, PWP has chosen not to provide funding to MWD for ULFT rebates. Between 1999 and 2008, PWP has provided incentives to replace approximately 3,373 ULFTs saving approximately 1,750 AFY.

Through MWD's aforementioned Save Water Save a Buck program PWP continues to provide rebates for urinals for multi-family customers with five or more units. Zero and ultra low water urinals, less than or equal to 0.25 gpf, are eligible for rebates of $200 for retrofits and $60 for new construction.

This page intentionally left blank.

Section 7
Climate Change

The Urban Water Management Planning Act does not require urban water suppliers to address climate change as part of an UWMP. However, DWR suggests urban water suppliers consider water supply and demand impacts related to climate change.

7.1 Introduction

PWP has considered impacts of climate change during development of its WIRP and UWMP. Climate change is a global concern, but is particularly important in the western United States where water supply sources are limited and in many cases derived from snowpack. Climate change can impact both imported water supplies from MWD and local supplies.

Generally speaking, any water supplies that are dependent on natural hydrology are vulnerable to climate change, especially if the water source originates from mountain snow pack. For Pasadena, the most vulnerable water source from climate change is imported water. However, local sources can expect to see some changes in the future as well. In addition to water supply impacts, changes in local temperature and precipitation are expected to alter water demand patterns.

Scientists predict future scenarios using highly complex computer general circulation models (GCMs). Although most of the scientific community agrees that climate change is occurring and, as a result, mean temperatures for the planet will increase, the specific degree of this temperature increase cannot be accurately predicted. Predictions of changes in precipitation are even more speculative, with some scenarios showing precipitation increasing in the future and others showing the opposite.

To place the global coarse-scale climate projections to a regional level that incorporates local weather and topography, the GCMs are "downscaled". The regional areas of interest in assessing climate change impacts to PWP include local areas (vicinity of Pasadena) and areas of imported water origin (Northern California and Colorado River Basin).

7.2 Local Supply and Demand Impacts

Most experts believe that because of the uncertainty involved with each model, several models should be used to test the potential impact of climate change. Future projections of precipitation and temperature were obtained and downscaled to a region inclusive of PWP's service area for six GCMs under two greenhouse gas emission scenarios (higher and lower). [1] [2]

[1] Dan Cayan and Mary Tyree (University of California, San Diego Scripps Institute of Oceanography) provided downscaled data for Pasadena under two emissions scenarios from six climate change models: CNRM CM3, GFDL CM2.1, Micro3.2 (medium resolution), MPI ECHAM5, NCAR CCSM3, and NCAR PCM1.

[2] Note: these scenarios do not bracket the highest and lowest emission futures possible, but represent a status quo approach (A2) and a pro-active mitigation (B1) approach to reduce carbon emissions.

Figures 7-1 and 7-2 plot the changes in projected average annual temperature and precipitation, respectively, for the model scenarios. The bold lines represent the running average of all six models for each emission scenario.

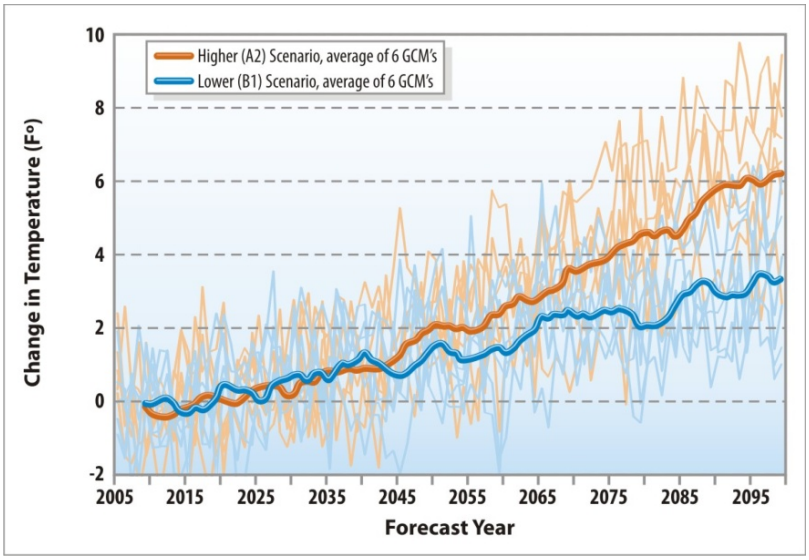

Figure 7-1. Climate Change Impacts to Local Temperature

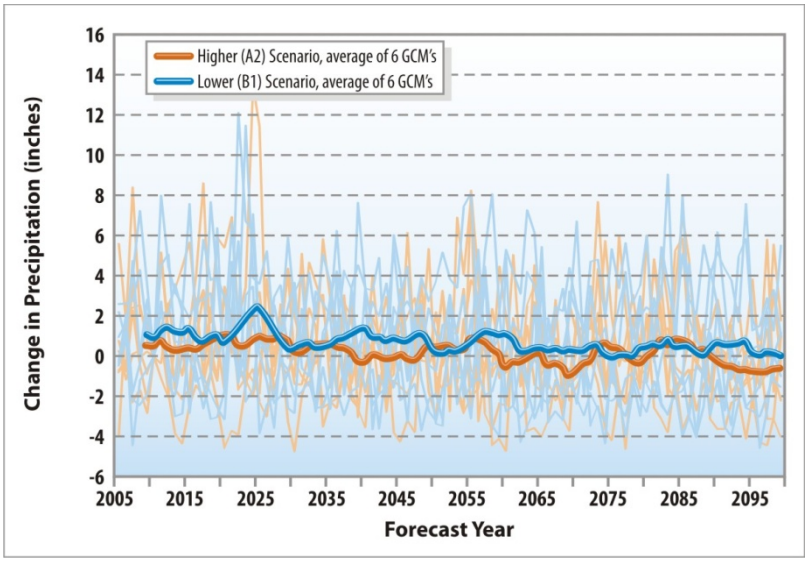

Figure 7-2. Climate Change Impacts to Local Precipitation

Local climate changes near the Pasadena vicinity are expected to include:

- An increase in average temperatures that will be more pronounced in the summer than in the winter
- An increase in heat waves and droughts that will extend for a longer duration
- A decrease in precipitation that, coupled with higher temperatures, will increase evaporation/transpiration
- An increase in short-duration/high volume intense storm events during the winter

The impact of these climate effects will likely be increased water demands for irrigation and cooling purposes, and decreased local surface runoff. Other impacts might include increased fire events that could impact water quality and sedimentation, as well as decreased groundwater recharge due to lower soil moisture.

7.3 Imported Water Impacts

7.3.1 State Water Project

To date, most studies on climate change impacts to California's water supply have been conducted for the Northern California region. In August 2010, DWR released the 2009 State Water Project Delivery Reliability Report, which specifically analyzes changes in volume of water available under various climate change scenarios. DWR predicted that SWP deliveries could be reduced by as much as 15 percent in some cases as illustrated in Figure 7-3.

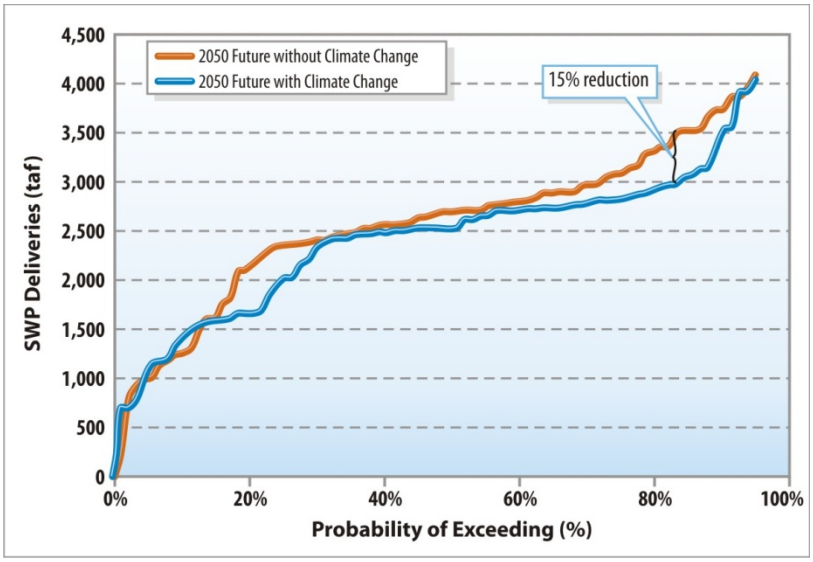

Figure 7-3. Climate Change Impacts to Imported Water Source: DWR, 2009.

The primary effects of climate change to the Delta supply include, among others:

- More precipitation will fall as rain than snow
- Reduced Sierra snowpack
- Shifted timing of snowmelt runoff into streams – spring runoff comes earlier resulting in increased winter flows and decreased spring flows
- Increased flood events.

The most severe climate impacts in California are expected to occur in the Sierra watershed, which is where the SWP supply originates. Therefore, imported water supply is extremely vulnerable to climate change.

7.3.2 Colorado River Aqueduct

Although many research efforts are underway, there have not yet been any final reports quantifying potential changes in supply to California from the Colorado River. At this time, the assumption is that there would be similar patterns as the SWP impacts.

7.4 Adaption and Mitigation

Climate change strategies fall under two main categories: adaptation and mitigation. For water resources planning, a climate change adaptation strategy involves taking steps to effectively manage the impacts of climate change by making water demands more efficient and relying on supply sources that are less vulnerable to climate change thereby increasing system reliability. A mitigation strategy involves proactive measures that reduce greenhouse gas emissions. Projects identified in the preferred WIRP alternative and discussed throughout this UWMP provide both adaption and mitigation benefits. These benefits improve system reliability given the current understanding of climate change impacts.

Adaption benefits provided by the planned projects include:

- Wet weather storage for intense winter storm events (Devil's Gate Dam)
- Enhanced stormwater capture and groundwater replenishment
- Groundwater storage of imported water to provide a sustainable supply through extended heat waves and drought
- Aggressive conservation to reduce the demands for irrigation and cooling towers
- Increased utilization of recycled water, which is independent of climate impacts
- Reduced overall reliance on imported water, which is highly vulnerable to climate change

Mitigation benefits include a reduction in greenhouse gas emission of approximately 20,000 metric tons by 2035 through the reduction of imported water demands equating to almost a 50% reduction from the status quo. Imported water demands utilize significant energy to pump water from the Bay-Delta region and the Colorado River Aqueduct.

CDM®

www.cdm.com